ANALYSIS OF THE OUTCOME OF MANDIBLE

FRACTURE MANAGEMENT

A dissertation submitted to

THE TAMIL NADU M.G.R. MEDICAL UNIVERSITY

In partial fulfillment of the Regulations of the award of degree of

M.Ch.

(PLASTIC AND RECONSTRUCTIVE SURGERY)

Branch – III

AUGUST 2015

DEPARTMENT OF PLASTIC AND
RECONSTRUCTIVE SURGERY
COIMBATORE MEDICAL COLLEGE HOSPITAL
COIMBATORE – 641 018

CERTIFICATE

This is to certify that this dissertation titled " **ANALYSIS OF THE OUTCOME OF MANDIBLE FRACTURE MANAGEMENT "** submitted by **Dr.A.KAVITHA PRIYA** to the faculty of Plastic Surgery, The Tamil Nadu Dr.M.G.R. Medical University, Chennai in partial fulfillment of the requirement for the award of MASTER OF CHIRURGIE IN **PLASTIC AND RECONSTRUCTIVE SURGERY** Branch – III for the August 2015 Examination is a bonafide research work carried out by her under our direct supervision and guidance.

Prof.Dr.B.Asokan, M.S. (Gen), M.Ch., (Plastic)
Prof and Head of the Department,
Department of Plastic Surgery,
Coimbatore Medical College,
Coimbatore.

Prof.Dr.A.Edwin Joe, M.D., BL
The Dean,
Coimbatore Medical College,
Coimbatore.

DECLARATION

I **Dr.A.KAVITHA PRIYA,** solemnly declare that the dissertation titled "**ANALYSIS OF THE OUTCOME OF MANDIBLE FRACTURE MANAGEMENT"** is a bonafide research work done by me at Coimbatore Medical College, during 2012-2015 under the guidance and supervision of Prof.Dr.B.Asokan, M.S. (Gen), M.Ch., (Plastic). This dissertation is submitted to The Tamil Nadu Dr. M. G. R. Medical University, towards partial fulfillment of the University regulations for the award of M.Ch., Degree (Branch III) in plastic and reconstructive surgery.

Place : Coimbatore **Dr.A.KAVITHA PRIYA,**
Date :

Coimbatore Medical College

COIMBATORE, TAMILNADU, INDIA - 641 014

(Affiliated to The Tamilnadu Dr. MGR Medical University, Chennai)

ETHICS COMMITTEE

CERTIFICATE

Name of the Candidate : A. KAVITHA PRIYA

Course : M ch PLASTIC SURGERY

Period of Study : 2012 - 2015

College : COIMBATORE MEDICAL COLLEGE

Dissertation Topic : ANALYSIS OF OUTCOME OF MANDIBLE FRACTURE MANAGEMENT.

The Ethics Committee, Coimbatore Medical College has decided to inform that your Dissertation Proposal is accepted / ~~Not~~ ~~accepted~~ and you are permitted / ~~Not~~ ~~permitted~~ to proceed with the above Study.

DEAN
Coimbatore Medical College & Hospital,
Coimbatore

ACKNOWLEDGEMENT

I owe my thanks to **Prof. Dr.A.EDWIN JOE, M.D., BL, The DEAN, COIMBATORE MEDICAL COLLEGE**, for allowing me to avail the facilities needed for my dissertation work.

I am greatly indebted to **Prof. Dr.B.ASOKAN, M.S. (Gen), M.Ch., (Plastic)** Professor and Head, Department of Plastic and Reconstructive surgery, for his valuable guidance in completing this dissertation.

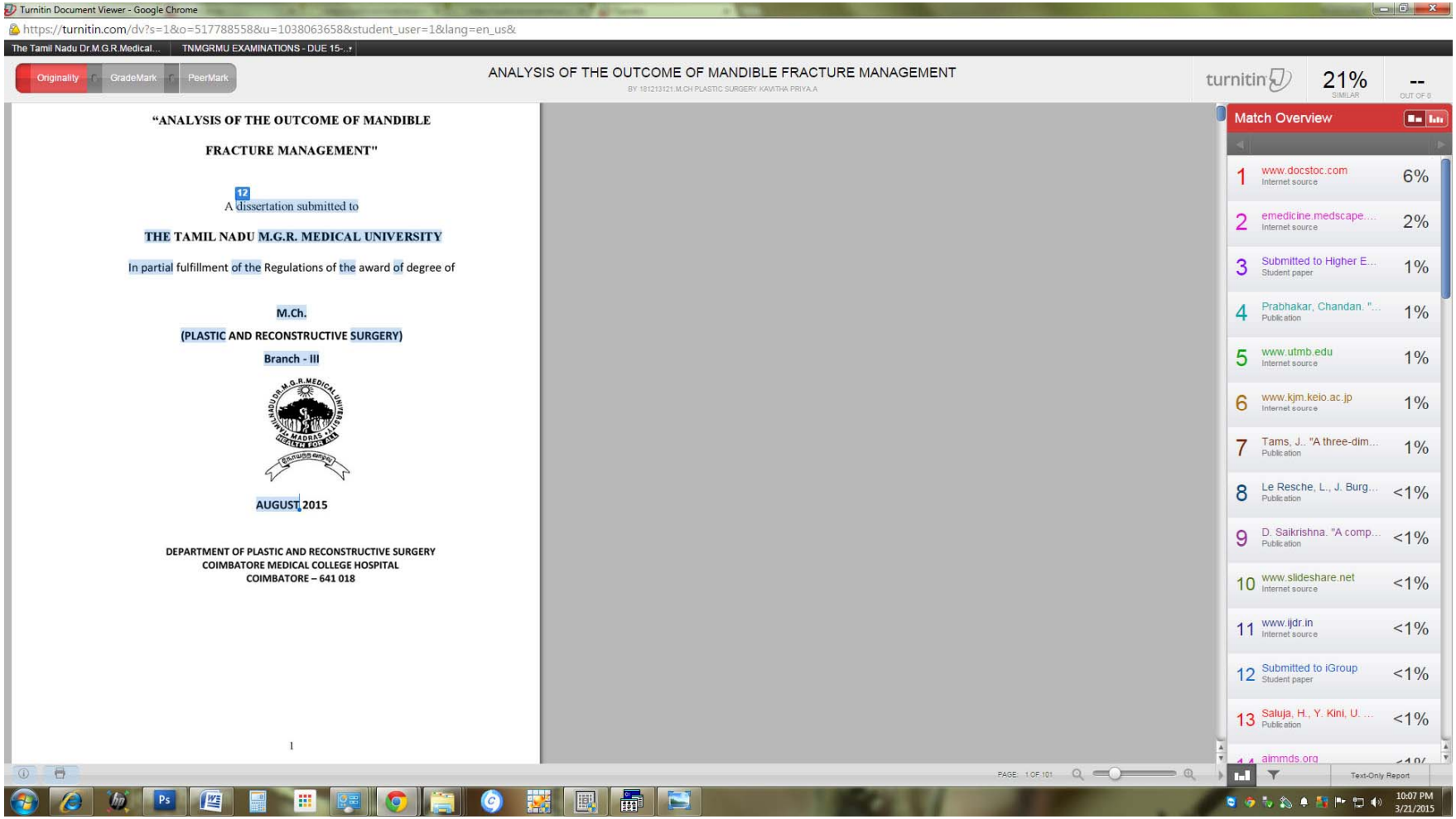
I would like to thank my Associate **Prof. Dr.N.SEKAR, M.S.(Ortho), M.Ch. (Plastic)** for his guidance in completing this dissertation.

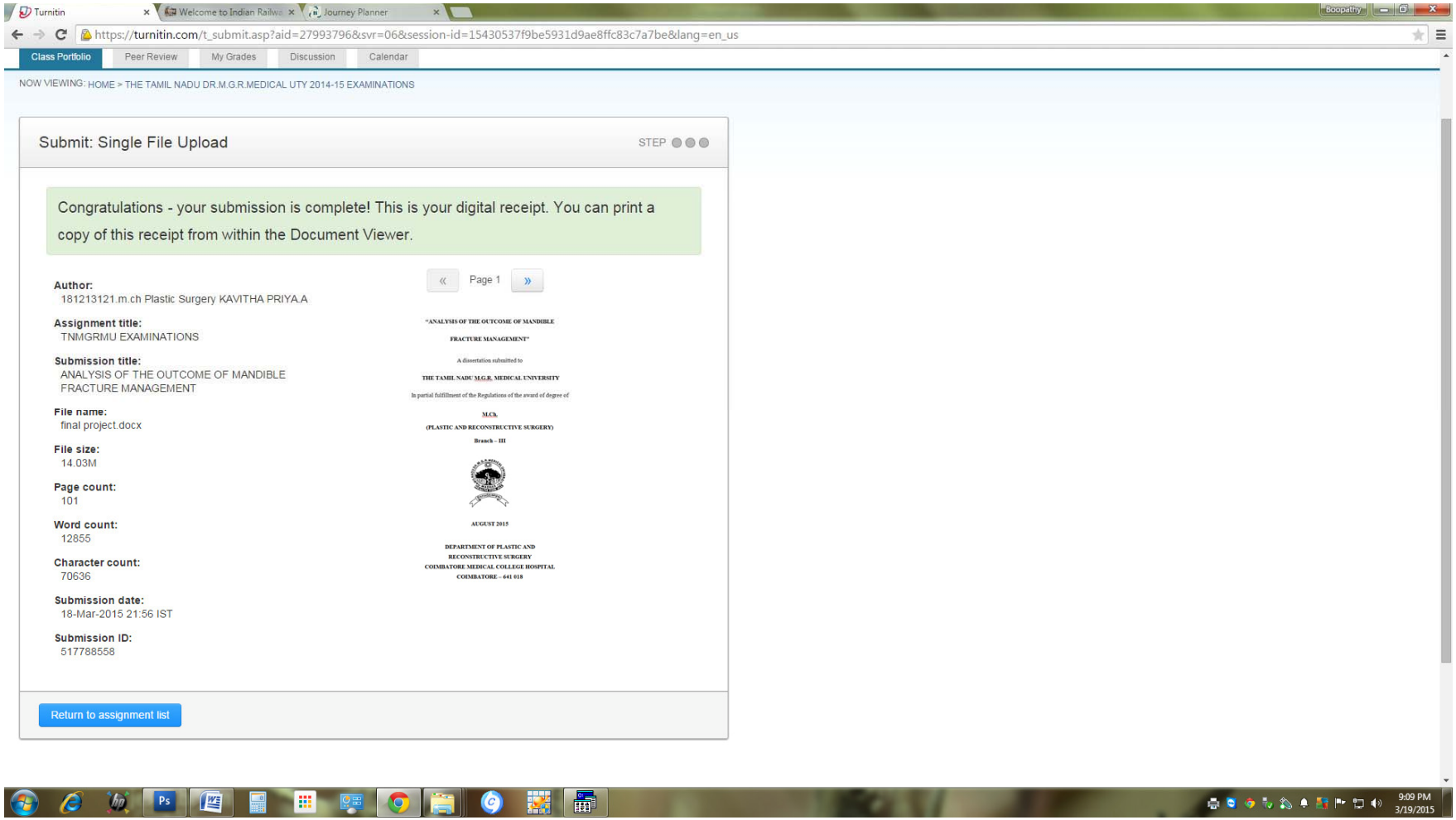
I am also deeply thankful to our Assistant Professors, Dr.V.P.Ramanan, Dr.R.Senthil Kumar, Dr.S.Prakash and Dr.M.Sundararaj for their valuable suggestions and inputs in preparing this dissertation.

I also thank our college Ethics Committee for their certification of approval. I also thank my co-post graduates for their help in preparing this dissertation.

Finally, I will be failing in my duty if I don't thank my patients who have been my greatest source of inspiration in my work.

Dr. A.KAVITHA PRIYA


Turnitin Document Viewer - Google Chrome
https://turnitin.com/dv?s=1&o=517788558&u=1038063658&student_user=1&lang=en_us&
The Tamil Nadu Dr.M.G.R.Medical...
TNMGRMU EXAMINATIONS - DUE 15-..
Originality
GradeMark
PeerMark
ANALYSIS OF THE OUTCOME OF MANDIBLE FRACTURE MANAGEMENT
BY 181213121.M.CH PLASTIC SURGERY KAVITHA PRIYA.A
turnitin
21%
SIMILAR
--
OUT OF 0
"ANALYSIS OF THE OUTCOME OF MANDIBLE
FRACTURE MANAGEMENT"
A dissertation submitted to
THE TAMIL NADU M.G.R. MEDICAL UNIVERSITY
In partial fulfillment of the Regulations of the award of degree of
M.Ch.
(PLASTIC AND RECONSTRUCTIVE SURGERY)
Branch - III
AUGUST 2015
DEPARTMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY
COIMBATORE MEDICAL COLLEGE HOSPITAL
COIMBATORE – 641 018
1
Match Overview
1 www.docstoc.com Internet source 6%
2 emedicine.medscape.... Internet source 2%
3 Submitted to Higher E... Student paper 1%
4 Prabhakar, Chandan. "... Publication 1%
5 www.utmb.edu Internet source 1%
6 www.kjm.keio.ac.jp Internet source 1%
7 Tams, J.. "A three-dim... Publication 1%
8 Le Resche, L., J. Burg... Publication <1%
9 D. Saikrishna. "A comp... Publication <1%
10 www.slideshare.net Internet source <1%
11 www.ijdr.in Internet source <1%
12 Submitted to iGroup Student paper <1%
13 Saluja, H., Y. Kini, U. ... Publication <1%
aimmds.org
PAGE: 1 OF 101
Text-Only Report
10:07 PM
3/21/2015


Turnitin
Welcome to Indian Railwa
Journey Planner
https://turnitin.com/t_submit.asp?aid=27993796&svr=06&session-id=15430537f9be5931d9ae8ffc83c7a7be&lang=en_us
Class Portfolio
Peer Review
My Grades
Discussion
Calendar
NOW VIEWING: HOME > THE TAMIL NADU DR.M.G.R.MEDICAL UTY 2014-15 EXAMINATIONS
Submit: Single File Upload
STEP
Congratulations - your submission is complete! This is your digital receipt. You can print a copy of this receipt from within the Document Viewer.
Author:
181213121.m.ch Plastic Surgery KAVITHA PRIYA.A
Assignment title:
TNMGRMU EXAMINATIONS
Submission title:
ANALYSIS OF THE OUTCOME OF MANDIBLE FRACTURE MANAGEMENT
File name:
final project.docx
File size:
14.03M
Page count:
101
Word count:
12855
Character count:
70636
Submission date:
18-Mar-2015 21:56 IST
Submission ID:
517788558
« Page 1 »
"ANALYSIS OF THE OUTCOME OF MANDIBLE FRACTURE MANAGEMENT"
A dissertation submitted to
THE TAMIL NADU M.G.R. MEDICAL UNIVERSITY
In partial fulfillment of the Regulations of the award of degree of
M.Ch.
(PLASTIC AND RECONSTRUCTIVE SURGERY)
Branch – III
AUGUST 2015
DEPARTMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY
COIMBATORE MEDICAL COLLEGE HOSPITAL
COIMBATORE – 641 018
Return to assignment list
9:09 PM
3/19/2015

CONTENTS

INTRODUCTION

Face is the most admirable part of our body. Facial injury is the most common cause of disfigurement and affects the personality of the individual very much.

The most frequently injured facial bone is mandible after nasal bone because it is the most mobile and prominent facial bone .The mandibular fractures outnumbers zygomatic and maxillary fractures by a ratio of 6:2:1 respectively.

Fractures of mandible invariably produce malocclusion if not treated properly. Knowledge of the dentition is thus an absolute prerequisite for the proper treatment of jaw fractures.

Various techniques that are advocated in the literature to manage mandibular fractures vary ranging from bandages and external appliances, extra oral and intraoral appliances, mono maxillary wiring, intermaxillary wiring, plates and screws.

Restoration of the occlusion usually indicates anatomic reduction and proper positioning of the mandible and facial bones. Our goal should be restoration of the function without any morbidity at the earliest .

AIM

To analyze the outcome of mandibular fracture fixation with eyelets, arch bars, miniplates and screws and assess the

1. Stability of the fixation
2. Occlusion after fixation
3. Comparing the jaw dysfunction (chewing ability) before and after treatment.
4. Post operative sequalae – such as post operative pain, bony and soft tissue infections, nonunion, nerve injury, osteomyelitis, malocclusion, and malunion, .

REVIEW OF LITERATURE

HISTORY

The first description of mandibular fracture was as early as **1650 BC**, when an **Egyptian papyrus** described the examination, diagnosis, and treatment of mandible fractures.

Hippocrates describe circumdental wires and external bandaging for reapproximation and immobilization.

Surgeons such as **Ceisus (Rome)** , **Avicenna (Islam) and Sushruta (India),** described treating the jaw fractures conservatively between **25 B.C. and 11 century AD.**

Sushruta recommended complicated bandaging , manual manipulation and heat to treat fractures of mandible

.

The importance of occlusion during the treatment of fractures was studied by **Avicenna (980 to 1037A.D).** This concept is followed still today nearly 1000years after his description.

Salerno of Italy, in 1180 wrote in a textbook the importance of establishing proper occlusion.

Maxillomandibular fixation was first described in **1492**, in an edition of the book **Cirugia** printed in Lyons.

Dental prosthetic devices were used to immobilize fracture fragments.[77] by **Chopart and Desault.**

Until 19th century fracture mandible was treated with wrap, external bandages and sometimes with bridle wire.

Gilmer reformed the treatment of fracture mandible by using fixed full arch bars on the maxilla and the mandible.

Numerous splints were devised in the 19th century, the most important was **Gunning (1866) and Bean (1865).** This period was known as **"Prosthetic era"** in fracture management.

Mandibular fracture stabilization by means of a screw plate system was described by **Hausmann in 1886**.

Solid steel plate held by 4 screws for fixation.[54] was first used by **Schede in 1888.**

Angle described many methods of Intermaxillary fixation that used bands and other orthodontic techniques. Angle criteria of occlusion is still followed.

Skeletal fixation became popular during the world war I and II.

Roger Anderson (1936) improvised the method and produced an appliance by which fracture fragments could be held and maintained by means of pins or screws inserted through skin.

Circumferential wiring was popularised by **G.V. Black and Ivy (1921).**

Kazanjian used transosseous wiring placed through an intraoral approach into the alveolar part of the bone during the first World war.

Cole in 1917 used silver plates and screws on either side of fracture and attached silver wires to the plates for immobilize .

Vorschutz (1934) introduced two large screws through the skin into the bone, reduced the fracture and held the screws in position with use of Plaster of Paris bandage.

Rigid compression system to the bony cortex using plate and screw was designed **by Danis in 1949**.

Open reduction with Internal fixation was described by **Kruger (1964)** as a definite method **.** The need for adding Maxillomandibular fixation to the internal fixation was stressed by him.

The technique of rigid internal fixation was developed and popularized by **Arbeitsgemeinschaft fur Osteosynthesefragen**/Association for the Study of Internal

Fixation (**AO/ASIF**) in Europe in the **1970s**. The basic principles of the AO, outlined by **Spiessl**, call for primary bone healing under conditions of absolute stability.[17]

Rigid internal fixation must neutralize the forces (compression, torsion, tension, shearing) developed during functional loading of the mandible to allow for immediate function,. this was accomplished by inter fragmentary compression plates. Use of superior border plate or arch bars to counter traction or tension forces at the superior border.[11] and the use of an inferior border plate to counter compression forces.

AO reconstruction plates has created an impacted in the management of infected and comminuted mandibular fractures. There was 7.5% infection rate in treatment of mandibular angle fractures with an AO reconstruction plate without intermaxillary fixation (IMF) as reported by **Ellis** .

During the same time **Spiessl** was expounding the AO doctrine, **Champy et al in France** [15] were developing the concept of adaptive osteosynthesis.

Champy in 1978 advocated transoral placement of small, malleable, thin, stainless steel miniplates with monocortical screws along an ideal line of osteosynthesis .

Champy believed that compression plates were unnecessary because of masticatory forces produce a natural strain of compression along the inferior border.

These 2 changes of AO rigid internal fixation and the Champy method of monocortical miniplates revolutionized the treatment approach to mandibular fractures. Many fractures previously treated with closed reduction or open reduction with wire osteosynthesis are now commonly treated with open reduction with plate and screw fixation.

Wagner W F et al [79] (1979) studied the extraoral open reduction of mandibular fracture and the associated morbidity and concluded that open reduction of mandibular angle fracture associated with removal of teeth from fracture line resulted in the greatest incidence of complication.

The effects of plating on bone blood supply of mandible was studied by **Grunst [33] (1980)** . Plates provide excellent stability of the fragments and allow early restoration of medullary blood supply ,but the cortical blood supply is very much interfered by the plates.

K.E. Kahn Berg et al [42] (1980) advocated an intraoral bone plate method for mandibular fractures, emphasized the need for Maxillomandibular fixation and therefore limiting the period of patient disability.

Monty et al [53] (1983) evaluated bone repair in the mandible by a histological and biometric comparison between rigid and semi rigid fixation and concluded that healing by primary intention required rigid internal fixation and results in superior healing.

Wald. R.M et a1 [80] (1988) prospectively evaluated the efficacy of non-compression miniplates selected mandibular fracture.

Brown. J.S et al [12] (1989) retrospectively studied the fate of miniplates and concluded that there is no advantage in removal of the plate after fracture union.

Mitchell M. Rubin et al [51] (1990) retrospectively analyzed and concluded thatthere had been no difference in the complications when the third molar teeth in line of fracture was extracted or retained.

J.S. Brown et al [39] (1991) demonstrated the post operative functional improvement and the weight gain after internal fixation when compared with intermaxillary fixation . Patient treated with intermaxillary fixation had restricted airway.

Smith.W.P [72] (1991) did a retrospective study on delay in surgery beyond 24 hours with miniplate osteosynthesis and surgery within 24 hours showed no difference and he demonstrated that the incision lines were more important in preventing wound infection and dehiscence rather than the implants. Stainless steel appears effective in short term use.

Jeffrey.C.Posnick et al [41] (1991) in their retrospective analysis of pediatric facial fractures reviewed 137 patients and found that mandibular (34%) and orbital (23%) fractures predominated. Fewer mid face fractures (7%) were sustained than

would be expected in similar adult patients. Most fractures resulted from traffic related accidents(50%), falls (23%) and sports (15%) Closed reduction with Maxillomandibular fixation was frequently chosen for children with Condyle fractures and open reduction (35%) for other regions of face.

Sindet et al [69] (1992) compared the treatment of fractures of mandible treated with or without Maxillomandibular fixation and found that the miniplates gave good stabilization of mandibular fractures and allowed treatment without post reduction Maxillomandibular fixation.

Andres.J.J.Gonzalez et al [05](1992) analyzed retrospectively and found that mandibular fractures when Champy's plates were used , patients had experienced a shorter period of trismus than using closed reduction with Maxillomandibular fixation.

J. P. Hayter et al [38] (1993) analyzed the fractures of facial skeleton result in discontinuity of facial bones. He concluded that Osteosynthesis of the bones are needed to allow stable and uneventful healing.

The effects of screw length and number on tension bands were evaluated by **Richard. H.Haug [65] (1993).** He concluded that the maximum resistance to vertical force was achieved with three screws per segment and no additional benefit of placing fourth screw.

Edward Ellis et al [20] (1993) used two 2.4 mm DCP through a trans oral incision using trans buccal trochar instrumentation with mandibular angle fracture. He said that the technique was easy but resulted in high rate of infection.

Fordyce A.M. et a1 [29] (1994) in his retrospective study concluded that the avoidance of pre and post operative Maxillomandibular fixation was safe and economical for the patient.

Ellis E. et al [21] (1994) studied the effectiveness of two 2mm non compression miniplates for fractures of angle of mandible and found that the use of two plates was easy, but resulted in high of infection rate.

Edwards TJ et al [23] (1994) studied for relationship between fracture severity and complication rate in miniplate fixation. He found that there is a strong relationship between complication rate and fracture severity.

Nakamura. S et al [55] (1994) analyzed the complications of miniplate osteosynthesis and found that malocclusion 3,6%, exposure of miniplates 3%, delayed union1,8% and infections1.0% .

Y.V. Tuavinen et al [84] (1994) analyzed retrospectively 269 patients with mandible fractures treated with miniplates (Titanium) using Champy's principles and concluded that semi rigid fixation of mandible fracture with miniplate was an ideal procedure in the management of these injuries.

Gregory.S.Tate et al [32] (1994) recorded voluntary bite forces in patients who were treated with rigid internal fixation for mandibular angle fracture and controls. He observed that there was less molar bite forces on the side of fracture when compared with controls.

R.A. Loukota et al [60] (1995) in their mechanical analysis of maxillofacial miniplates and found the by repeated bending the plate will result in decrease in stiffness .

JI Cawood [13](1995) compared 50 cases of mandibular fractures treated by mini plate osteosynthesis with Maxillomandibular fixation. He concluded that the plates have good recovery rate of normal jaw function and body weight when compared with Maxillomandibular fixation.

Vivek Shetty et al [78] (1995) found that compressive fixation system (DCP, Lag screw, locking plate,) are bio-mechanically superior to adaptive system (Champy miniplate, Mennen clamp plate) and provided immediate functional stability.

Valentino et al [77](1995) analyzed the use of Maxillomandibular fixation with miniplate osteosynthesis and without supplemental Maxillomandibular for a 5 year period. Their rates of major complications were 11% and 9% with and without Maxillomandibular fixation, while total rate of complications were 17% with supplemental Maxillomandibular fixation and 20% without supplemental Maxillomandibular fixation and concluded that there was no statistical significance with the use of Maxillomandibular fixation.

Richard H. Haug et al [65] (1995) compared the use of superior border wiring with open reduction and microplate screw technique for angle fracture and concluded that with minimal effort, more convenient access, less stripping of periosteum, monocortical screw placement and less chance of neurovascular injury this technique is far superior than the other.

Nicholas Gerard et al [56] (1995) modified the technique for using a mandibular angle superior border plate by burring the oblique ridge to place the plate.

J. Tams et al [36] (1996) performed a three dimensional study of loads across the fracture sites of the mandible and concluded that fixation devices for fractures should be strong enough to withstand the loads across the fracture. The miniplates and the dynamic compression plate system give good clinical results which are influenced by mechanics at fracture site and mechanical properties of the implants. Fracture characteristics such as direction shape and serration play important role by neutralizing the loads across the fracture. The mechanical properties of the implant such as strength and stiffness play an important role in stabilizing the loads across the fracture.

Walz et al [81] (1996) retrospectively analyzed 300 patients treated mandibular fracture with miniplate under LA and found fewer complications than in general Anesthesia. They recommended this technique for simple cases and in cases were general anesthesia is contraindicated.

Gerbino.G et al [30] (1997) retrospectively analyzed the results and complication of mandibular fracture with a tooth in the line of fracture treated using miniplates in fixation. Complication rates were higher when the tooth was extracted. So they recommended retaining the teeth in the line of fracture, unless there is an absolute indication of removing the teeth.

J.**Tams et al [37] (1997)** in his three dimensional study of bending and torsional movements for different fracture sites in the mandible. An in-vitro study, stated that the Symphysis fracture is usually treated by two bone plates, but as bending and torsion movements were in same range as for body fracture, indicate that symphyseal fracture and body fracture, treatment with one bone plate should be sufficient.

Schierie HP et al [67] (1997) in a prospective study treated mandibular angle fracture with 2mm miniplate concluded that two plate fixation may not contribute any advantages over single plate fixation.

T. Kawai et al [45] (1997) undertook radiological follow up to remove fixation materials after treatment of mandible fractures. They observed union in 85% of case in 3 months. So they recommended follow up radiological examination during the 5th week in patients less than 18 years and 9th week for older patients and recommended that fixation materials can be removed after 5 months after injury.

Robert A.Rudman et a1 [66] (1997) conducted a study to reassess Champy's findings which were instrumental in justifying the theory of tension band plating for mandibular Angle fracture. They used mandible which were

fabricated with photo elastic resin for their study. They found that stress fringes were present surrounding the outer screws, indicating that these screws were subjected to pull out forces. They concluded that there is greater force on the outer screws that may contribute to fixation failure, and that the theory of tension band plating for mandibular angle fracture is accurate but Champy's model is over simplified.

Bjorn et al [11] (1998) in their study on miniplate osteosynthesis in infected mandibular fractures, found that, by using miniplates the surgical trauma could be kept minimal and the periosteal blood supply could also be preserved by using an intraoral approach.

James.W.Sikes et al [40] (1998) compared the fixation strengths of locking head and conventional screws in fracture and reconstruction model. Due to the increased resistance to displacement with the locking head screws only two screws per segment were used in the reconstruction model. When four screws were used there was no significant difference between locking head and conventional screw types.

Alan S. Herford et al (1998) analyzed the use of a locking reconstruction plate system for fractures of mandible with defects and found them to be simple and advantageous over conventional bone plates by not requiring the plate to be compressed to the bone to provide additional stability.

Jose Moreno et al (2000) compared the complication rates associated with mandibular fracture managed with, 2mm miniplate, 2.5mm AO plates , 2.7mm A0 plates and Maxillomandibular fixation. The complications were directly related to the fracture severity rather than to the type of treatment used.

Mathod [49] (2000) in their study concluded that body of mandible was the common site of nonunion. Osteomyelitis ,unstable fixation and reduction, failure to provide antibiotics, teeth in fracture line, delay in treatment alcohol and drug abuse, inexperience of surgeons and lack of patient compliance are the other causes of nonunion .

Wolfgang Heideman et a1 [82] (2001) found that the drill free screws were superior to self tapping screws.

K.U.Fuller et al (2002) in their experimental study on combination of micro plate and miniplate for osteosynthesis of mandibular fractures found that the damage to dental roots or nerve when using two plates is high in the mental foramen region. With the use of microplates,the risk of injuring a dental root or mandibular nerve is reduced by 25%. The disadvantage of micro plate is that plates and screws are expensive.

Reza Bolourian et al [63] (2002) conducted a study to evaluate the efficacy of 2.0mm miniplates in mandibular fracture and Maxillomandibular fixation for 2 weeks was a viable treatment option.

Fuselier et al [29] (2002) evaluated the risk of mandibular angle fractures due to third molars. Patients with 3rd molar present had a 2.1 times greater chance of an angle fracture than did patients without third molars . There was a statistically significant variation in the risk of an angle fracture depending on 3rd molar position according to Pell and Gregory classification.

Ellis III et al [22] (2002) conducted a study to evaluate the use of a 2mm locking plate-screw system in 59 patients and found to be a stable fixation.

Feller. K et al [26] (2002) studied the combination of miniplate and micro plate for osteosynthesis of mandible fracture in the mental foramen region concluded that this combination of micro plate and miniplate was stable enough for early mobilization.

Dimitrolis G [19] (2002) in his retrospective clinical study compared the management of unilateral angle fracture of the mandible using the traditional approach of open reduction and internal fixation and intermaxillary fixation with the technique of open reduction and internal fixation without intermaxillary fixation. The use of intermaxillary fixation for the management of angle fracture is unnecessary, provided the skilled assistant was present to help manual reduction of the fracture site for plating. Without the use of intermaxillary fixation, it improved patient comfort but also reduces the operating time by up to one hour and accelerates discharge time by one to half days.

Marisa et al [48](2003) concluded that rigid internal fixation of mandibular fractures eliminates the need for inter-maxillary reduction while reducing the risk of postoperative displacement of fractured segments, allowing immediate return to function.

Ellis III et a1 [25] (2003) assessed the methods of treatment used and outcomes for 196 patients with comminuted mandibular fracture. They showed that the use of open reduction and internal fixation is associated with a low complication rate. However not all comminuted fractures are amenable to this treatment and in those alternatives such as closed reduction with Maxillomandibular fixation or the application of external pin fixation may be necessary.

Ralf Gutwald et al [61] (2003) studied the principle and stability of locking plates and concluded that, in miniplate fixation, increase torsion and gapping of bone fragments occurred during screw tightening when the plates were pressed onto the bone. When using conventional miniplates, it is essential to contour the plate precisely to the bone surface. Otherwise incongruence between bone surface and plate will be transferred to the mobile bone fragments during tightening of screws resulting in more extended gaps and torsion and will lead to primary loss of reduction. More torsional movements are expected in less rigid miniplates than the DCP or reconstruction plates and therefore miniplates are not recommended for comminuted and infected fracture.

Ayman Chritah et al [06] (2005) performed a prospective study on transoral 2.0mm locking miniplate fixation of mandibular fractures plus 1 week of Maxillomandibular fixation and the use of single 2.0mm locking titanium miniplates

in non-comminuted, non-infected mandible fracture plus one week of Maxillomandibular fixation was evaluated. The locking miniplate system has demonstrated higher stability across a fracture and the osteotomy site compared with conventional non-locking 2mm miniplates in-vitro studies.

Thomas. A. Chiodo et al [76] (2006) performed a laboratory study comparing the performance of locking versus non-locking 2mm mandibular fixation plates and their failure strengths on bovine ribs. They concluded that no significant difference was found between the 2 types of mandibular plates, it also suggested that the type and degree of failure were related to bone quality and surgical technique when using the 2mm mandibular plate.

In 2007, Vural E published his results of 16 patients who underwent manually provided intra-operative temporary Maxillomandibular fixation for open reduction and internal fixation. Of the 16 patients, only one patient had malocclusion.

In 2007, David Wilson studied mandibular angle fractures managed by open reduction and internal fixation. He divided the study group in to three groups based on the intra operative MMF utilized- group 1- Erich arch bar, group 2- 24 gauge inter dental wires and group 3- manual reduction. He found no significant difference in the outcome and complication in the three groups.

In 2009, Mathieu Laurentjoye [46] reviewed 184 patients who had manual reduction and semi rigid mini plate osteosynthesis for fracture mandible. The functional result was similar to that reported in literature.

ANATOMY

Mandible bone is U shaped and it is composed of two hemi mandible which fuse to form a single bone at the age of two years. It is a first pharyngeal arch derivative.

Parts of mandible

Hemi mandible consist of Parasymphysis, body, angle, Ramus, Condyle and Coronoid process united in the midline by Symphysis.(Fig.1,2).

Fig. 1

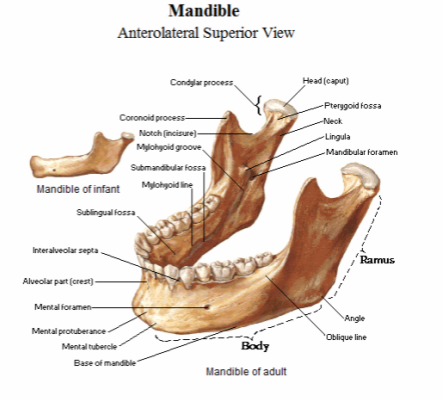
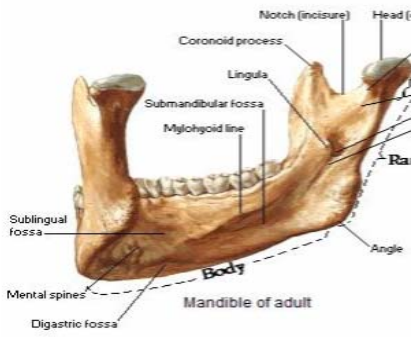


Fig. 2

Mandible left posterior view



Parasymphysis

It extends from midline to canine region.

Body of the mandible

It has upper and lower border and an inner and outer surface .

Outer surface of body

Symphysis menti - a ridge where the two body meet.

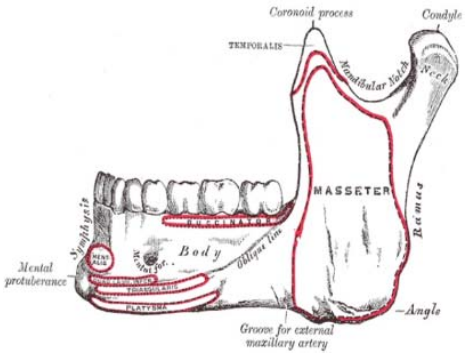
Mental protuberance - triangular projecting area in the lower part of midline.

Mental foramen - it lies in the interval between the premolar teeth which transmits mental nerve and vessels.

Oblique line - continuation of sharp anterior border of Ramus. Buccinator, depressor labii inferioris and depressor anguli oris arise from the line.

OUTER SURFACE OF MANDIBLE

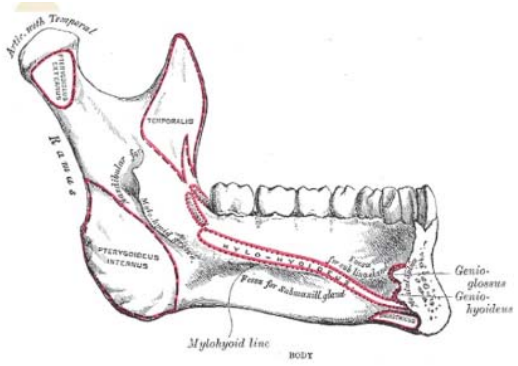
Fig .3



Incisive fossa - it is a depression which lies just below the incisor teeth, gives origin to mentalis and mental slips of the orbicularis oris.(Fig.3)

Inner surface of mandible

Fig .4



Mylohyoid line - prominent ridge running obliquely downwards and forwards from below the third molar tooth to the median area below genial tubercles. It gives origin to the Mylohyoid muscle, Superior constrictor muscle and Pterygomandibular raphe.(Fig.4)

Submandibular fossa - it lies just below the Mylohyoid line where the Submandibular gland lies.

Sublingual fossa - it lies above Mylohyoid line where sublingual gland lies.

Superior and inferior genial tubercles - four small elevations in posterior aspect of Symphysis menti. Superior genial tubercle gives origin to genioglossus and inferior genial tubercle gives origin to geniohyoid.(Fig.4)

Mylohyoid groove - it lies below the posterior end of Mylohyoid line extending to Ramus.

Upper border - it holds the sockets of teeth.

Lower border - near the midline an oval depression called digastric fossa, anterior belly of digastric muscle arises from the fossa. Platysma is inserted in this border.

Ramus of the mandible

Quadrilateral in shape and has upper, lower, anterior and posterior borders, lateral and medial surfaces.

Lateral surface

It is flat and having number of oblique ridges, Masseter inserted into it.

Medial surface

Mandibular foramen

It lies above the centre of Ramus leads to mandibular canal and descends into body of mandible and opens at mental foramen. Mandibular canal gives entry to Inferior alveolar nerve and vessels through mandibular foramen.(Fig.4)

Lingula - anterior margin of mandibular foramen. It gives attachment to Sphenomandibular ligament.

Mylohyoid groove - it lies below the mandibular foramen. Medial pterygoid muscle is inserted into the groove . In this groove, Mylohyoid nerve and vessels lie.

Upper border

Thin and curving downwards forming mandibular notch.

Lower border

Continuation of lower border of body. Posterior border is thicker than anterior border.

Coronoid process - flat triangular projection in the anterosuperior part of Ramus. Temporalis is inserted into it.

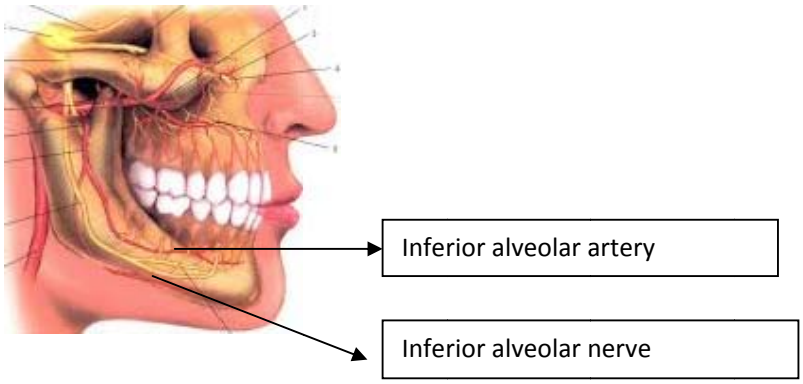
Condyle - an upward projection from poster superior part of Ramus. Fibro cartilage covers the head and articulates with temporal bone forming temporomandibular joint. Neck is the constriction below the head.

A depression in the anterior surface is called pterygoid fossa where lateral pterygoid muscle is inserted.

BLOOD SUPPLY

Inferior alveolar artery supplies the mandible. The artery arises from maxillary artery and descends between and Ramus and spheno mandibular ligament of the mandible. The inferior alveolar artery and nerve via mandibular foramen enters the body and exit via the mental foramen. The artery lies posterior to the nerve . Mandible also receives blood supply from its muscle attachments.(Fig.5)

Fig. 5



NERVE SUPPLY

Inferior alveolar nerve supplies the mandible .

Uniqueness of the mandible

Thick cortical bone with single vessel for endosteal blood supply. It varies with patient's age and amount of dentition. As the mandible atrophies ,the endosteal blood supply is decreased and periosteal blood supply is the dominant.

Mandible elevators

1. Masseter
2. Temporalis
3. Medial pterygoid

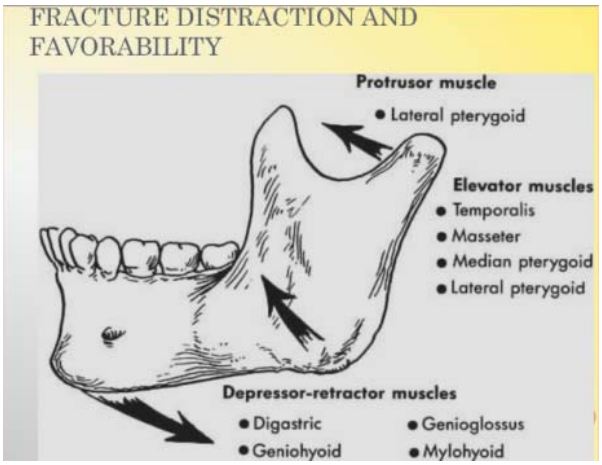
Mandible depressors

1. Lateral pterygoid
2. Mylohyoid
3. Digastric
4. Geniohyoid

All the muscles of mastication are supplied by mandibular branch (V3) of trigeminal nerve .

MUSCLE ATTACHMENTS AND DISPLACEMENT OF FRACTURES

Fig. 6



Masseter

It arises from the zygomatic arch and maxillary process of zygomatic bone. Inserted into the lateral surface of Ramus of mandible.

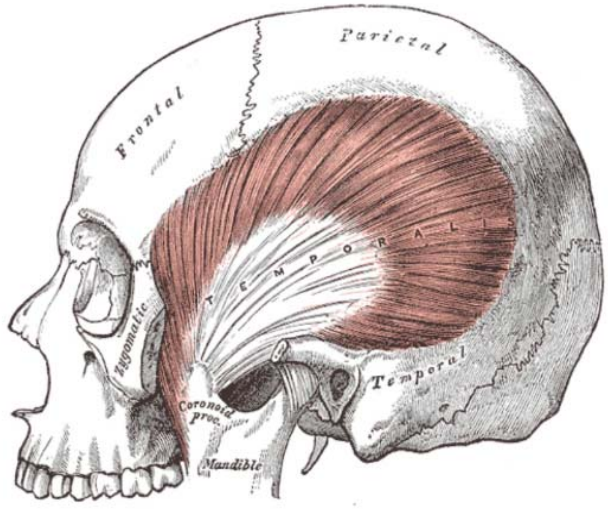
Action - Elevation of mandible.

Temporalis

It arises from the temporal fossa. It is inserted into the Coronoid process and anterior margin of Ramus of mandible .(Fig.7)

Action -Upper and anterior fibers elevate the mandible, posterior fibers retract the mandible.

Fig. 7

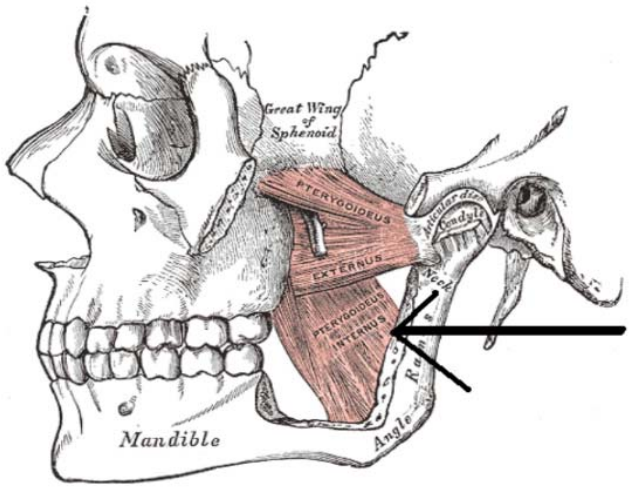


Medial Pterygoid

It has two heads superficial and deep. Deep head is larger and it arises from the medial surface of the lateral pterygoid plate the pyramidal process of the palatine bones. Superficial head arises from the tuberosity and pyramidal process of maxilla It is inserted into the medial surface of mandible near angle .

Action - Elevation and side to side movements of mandible.

Fig. 8



Lateral pterygoid

It has two heads. Superior head arises from the infratemporal fossa. Inferior head arises from the lateral surface of the lateral pterygoid plate and both fuse into a short thick tendon that inserts into pterygoid fovea in the neck of mandible and to the capsule of temporomandibular joint.(Fig.8)

Action - Side to side movement and protrusion of mandible.

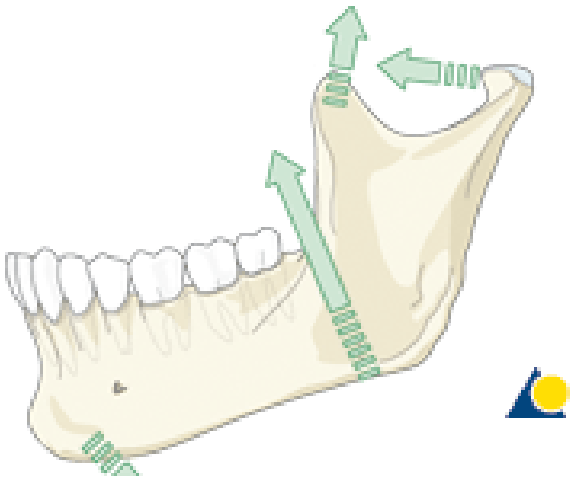
BIOMECHANICS OF MANDIBLE

Biomechanics of Mandible is a complex one. The forces applied to the mandible cause varying zones of tension and compression depending on where the bite force is located.

Muscle forces

Mandible is a hoop of bone that deforms with movement based on the origin and insertion of the muscles of mastication.

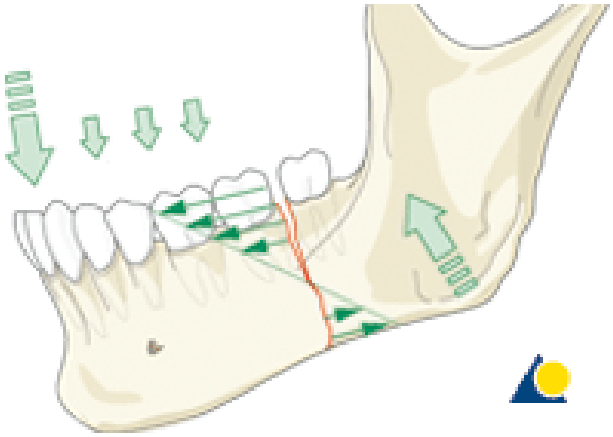
Fig. 9



Tensions and compression zones

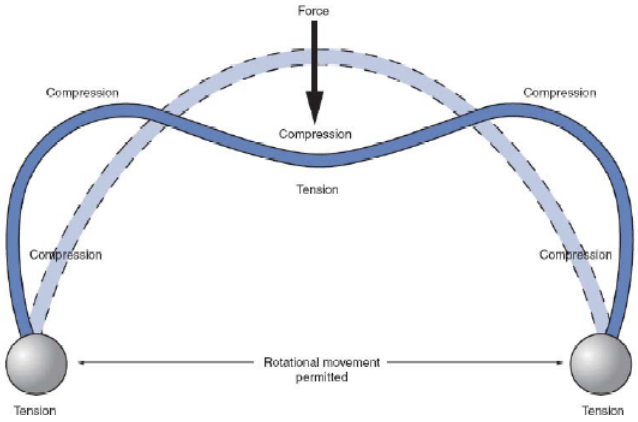
Superior border of the mandible is the tension zone and the inferior border is the compression zone.

Fig. 10



Hunting bow concept

Fig. 11



The mandible is similar to a hunting bow in shape, strongest in the midline (Symphysis) and weakest at both ends (condyles). The most common area of fracture in the mandible is therefore the condylar region. A blow to the anterior mandibular body is the most common reason for condylar fracture. The force is transmitted from the body of the mandible to the Condyle. The Condyle is trapped in the glenoid fossa. Commonly, a blow to the ipsilateral mandible causes a contra lateral fracture in the condylar region. (Fig.11)

If the impact is in the midline of the mandible, fractures of the bilateral condylar region are very common. With a condylar fracture, there is very often shortening of the Ramus on the affected side. This will result in an ipsilateral premature contact of the teeth. In case of bilateral fractures, the patient may present an anterior open bite. The condylar fragment may be displaced (most often laterally) based on the angulation of the fracture and predominant muscle pull.[17]

AO Principles of fixation

Superior border plate should be positioned on the ideal line of osteosynthesis. Inferior border plate should be located at the base of the mandibular body below the course of the mandibular canal in a longitudinal field.[17]

Ideal line of osteosynthesis

In the body region , it runs at the vertical height of the tooth apices from the canine region to the oblique line. This carries into the oblique ridge which turns into the anterior outer rim of the Ramus. According to **Champy**[15] in the transition to the Symphysis (anterior mandibular body) the insertion of two plates along the upper and lower border is mandatory because there may be rotational forces that have to be neutralized. In the posterior transition to the angle and Ramus a second plate just below the oblique ridge may be advantageous in a reduced bone stock due to impacted wisdom tooth or in major dislocations.

Fig. 12

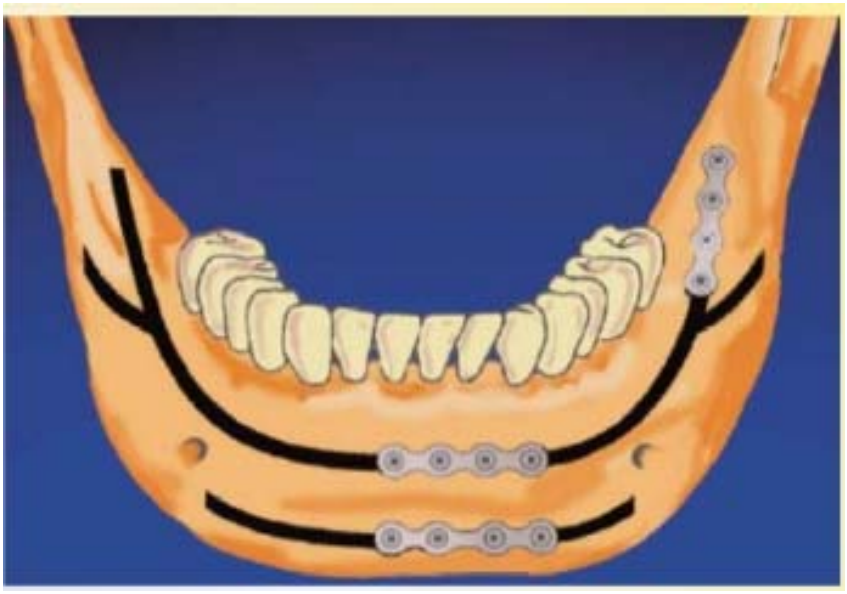
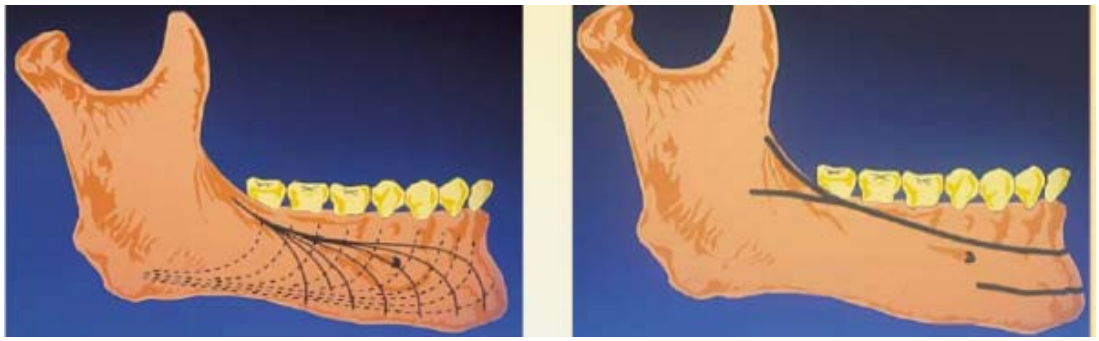


Fig. 13



Two point fixation (two plates) provide more stability than a single plate. Addition of a second plate provides more rigidity.

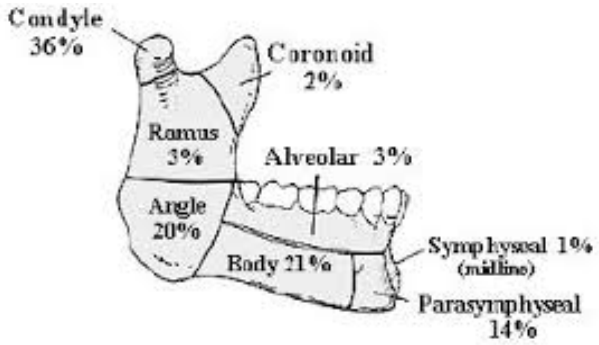
Sequence of plate insertion

Superior plate is inserted first in order to achieve preliminary fixation .This will prevent inadvertent displacement of the fragments during subsequent contouring and insertion of inferior border plate.

CLASSIFICATION

1**. Dingman and Natvig classification** according to the anatomical location site

Fig. 14



2.KRUGER'S General classification

a. Simple fracture / closed

b. Compound fracture / open

c. Communited fracture

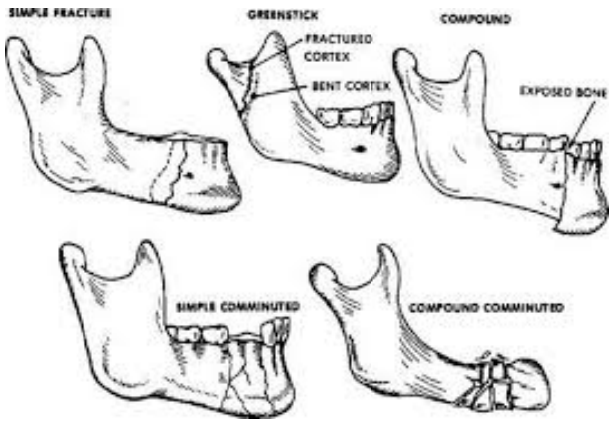
d. Complex or complicated fracture

e. Green stick fracture

f. Impacted fracture

g. Pathological fracture

Fig. 15



3. ROW AND KILLEY'S anatomical Classification

a. Fracture not involving basal bone

(e.g) Dento alveolar fracture

b. Fracture involving basal bone

1. Single unilateral fracture
2. Double unilateral fracture
3. Bilateral fracture
4. Multiple

4. Completeness of fracture

Complete fracture

Incomplete fracture

5. According to the presence or absent of tooth in relation to fracture line

Kazanjian and Converse

Class I - when the teeth are present on both sides of the fracture line

Class II - when the teeth are present on one side of the fracture line

Class III - when teeth are absent on both sides of the fracture line

6.Favorable and unfavorable fractures

Fig. 16

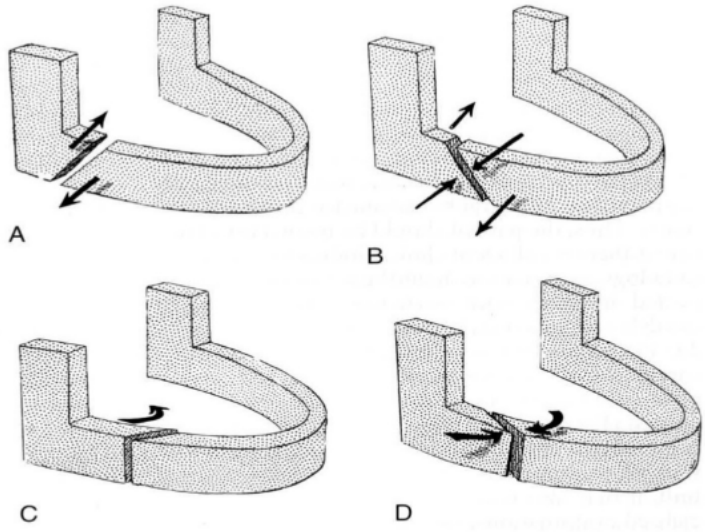
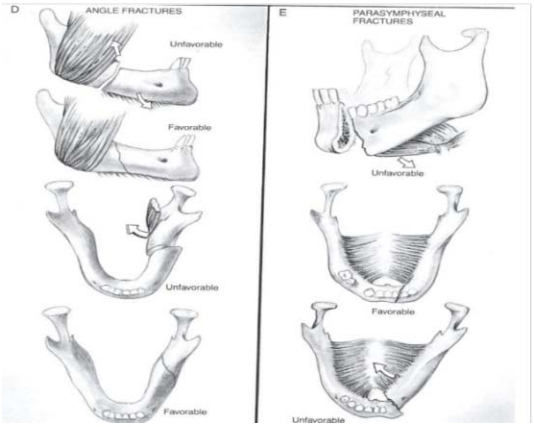


Fig. 17



a. Horizontally unfavorable, b. Horizontally favorable,

c. Vertically unfavorable, d. Vertically favorable

Mode of injury

1. RTA
2. Interpersonal violence
3. sports injury
4. Fall
5. Industrial trauma

Mechanism of injury

1. Direct violence
2. Indirect violence
3. Excessive muscular contracture - fracture of the Coronoid process because of sudden reflex contracture of the temporalis muscle.

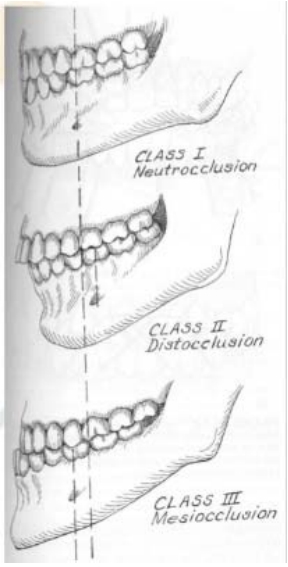
Angle classification of occlusion (1887)

Class I - Mesiobuccal cusp of the maxillary first molar occludes with the mesiobuccal groove of the mandibular first molar

Class II-Mesiobuccal groove of the mandibular first molar is distal to the mesiobuccal cusp of the maxillary first molar

Class III -Mesiobuccal groove of the mandibular first molar is mesial to mesiobuccal cusp of the maxillary first molar.

Fig. 18



METHOD OF FIXATION

Closed reduction

Indications

1. Non displaced favorable fractures
2. Fractures in children with developing dentition
3. Coronoid and high condylar fractures
4. Grossly comminuted fractures
5. Edentulous fractures with the use of prosthesis and circum mandibular wires

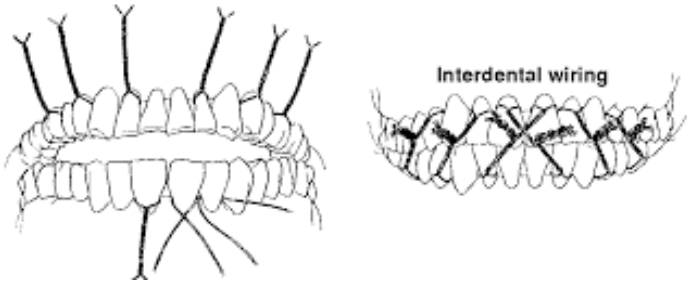
Splints

1. Gunning splints
2. Lingual splints

Wiring techniques

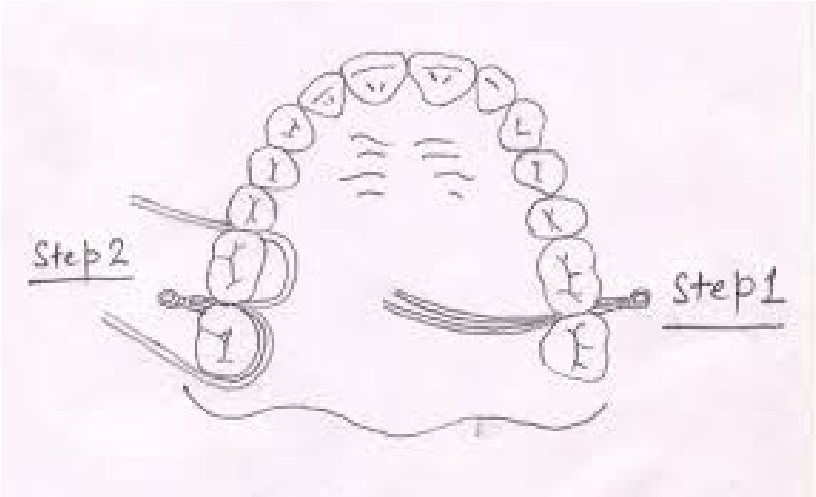
1. **Glimer method**

   Fig. 19



2. **Eyelet method**

   Fig. 20



3. **Erich arch bar method**

Fig. 21

4. Orthodontic bands
5. Acrylic splints

Maxillomandibular fixation

Maxillomandibular fixation refers to fixation of maxillary and mandibular teeth together with wiring . Three to four weeks of fixation is needed. Weight loss has been reported due to MMF.

1. Eyelet method
2. Arch bar method
3. Intermaxillary fixation screws(Fig. 22)

Fig. 22

4. Circumferential wiring
5. External pin fixation

Open reduction

Indications

1. Displaced unfavorable angle , body and parasymphyseal fractures
2. Patients with multiple facial fractures that require a stable mandible for basing reconstruction.
3. Bilateral displaced condylar fractures
4. Fractures of an edentulous mandible with severe displacement
5. Medically compromised patients
6. Comminuted fractures

Contraindications

1. Severely comminuted fractures
2. Grossly infected fractures
3. Patients with healing problems (radiation ,chronic steroid use, transplant patients)

Methods of fixation

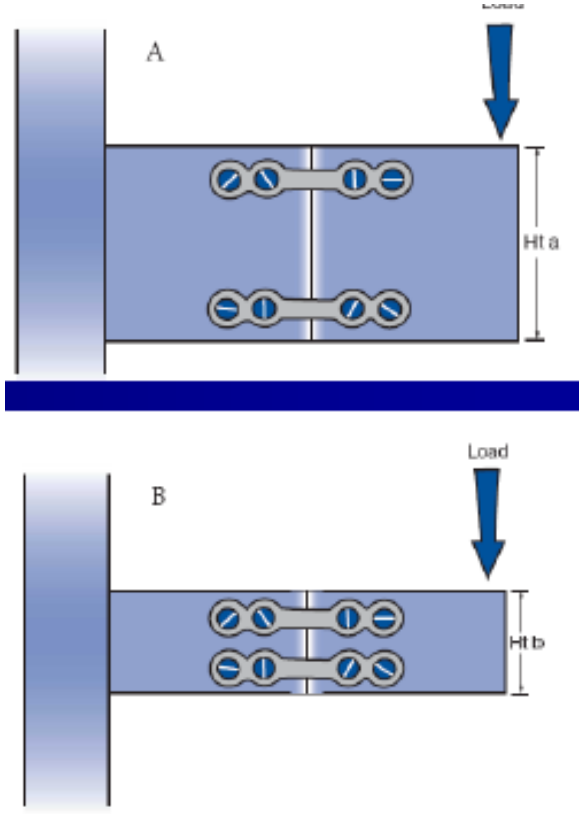
1. Dynamic compression plates

In plates with compression holes ,as the screw is tightened the screw -bone unit is moved towards the fracture site impacting against the bone on the opposite side of the fracture. Screws inserted bicortically This promotes primary bone healing.

2.Miniplates

The term “miniplate” refers to a plate thickness of 1.3 mm or less.(Fig.23). Mandibular miniplates are designed to be used with monocortical screws. Bicortical screws may be used for additional stability in some cases (with plate thickness being the limiting factor)

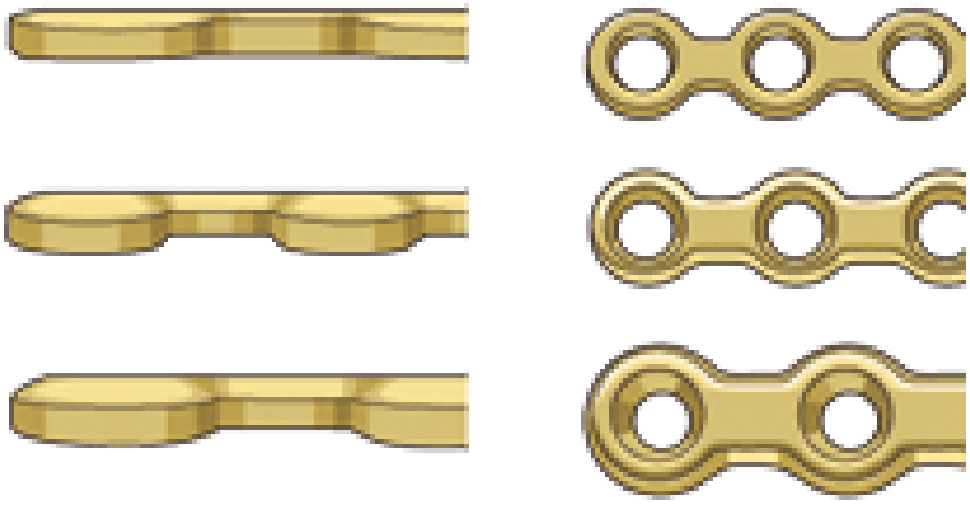
Fig. 23



3.Locking plates

In locking plate system the hole in the plate is engineered to accept screws that lock to it by a second thread under the head of the screw.(Fig.24) These plates function as internal fixators achieving stability by locking the screw to the plate. The advantage of this system is that it is unnecessary for the plate to have intimate contact with the underlying bone, making plate adaption easier leading to lesser alteration in the alignment of the segments and changes in the occlusal relationship upon screw tightening. It does not disrupt the underlying cortical bone blood supply. The screws are unlikely to loosen from the bone plate.

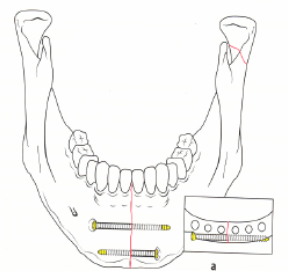
Fig. 24

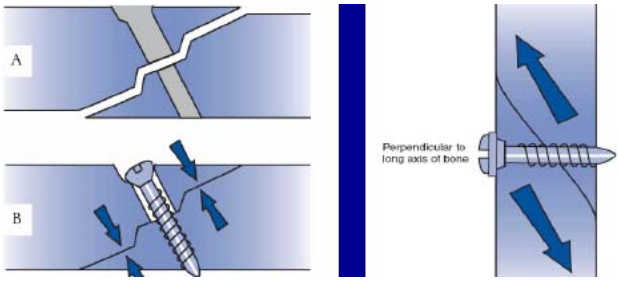


4. Lag screws

The principle is to place one or more screws through fragments so that the threads of screws take hold only in the far or deep cortical bone. This is effective in oblique fractures. The screw has to be placed perpendicular to the fracture. Since a single lag screw cannot resist rotation, at least two lag screws are required to resist the rotation.

Fig. 25 **Fig. 26**

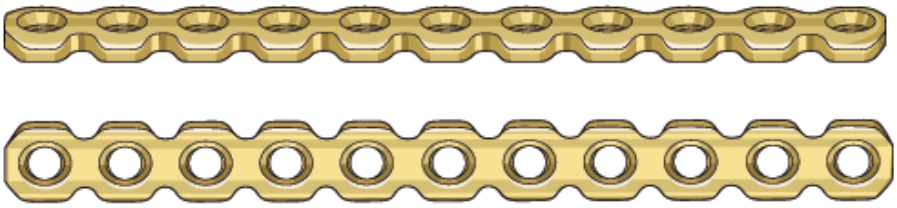




5.Reconstruction plate

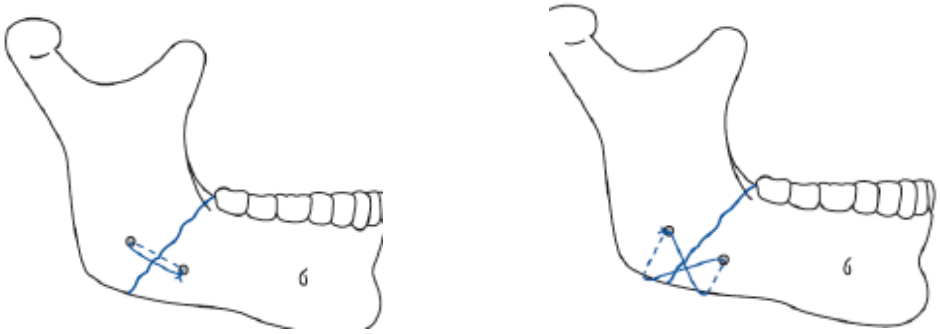
These plates are used for load bearing osteosynthesis of mandibular fractures.

Fig. 27



6.Intraosseous wire fixation

Fig. 28



ACCESS TO THE MANDIBLE

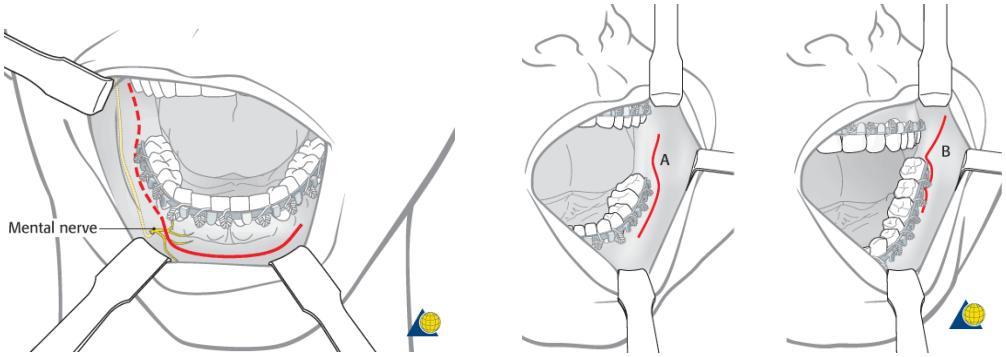
Good exposure of the fracture site is an absolute prerequisite for good surgical outcome. In face importance should be given for future scar and care should taken to avoid injury to nerves and muscles of facial expression.

INTRA ORAL ACCESS

1. TRANS ORAL LOWER BUCCAL SULCUS INCISION

Incision to be made in buccal mucosa in a U shaped manner(Fig.29) and not over gingiva. This incision gives a wide exposure of symphyseal, parasymphyseal and body fractures. Periosteal attachment should be retained whenever possible as the periosteal blood supply is the only remaining circulation. Hardware should be covered with well vascularized soft tissue two layers closure with muscle and mucosa is always effective . Mentalis should be repaired to avoid postoperative lip ptosis and lip ectropion.

Fig. 29 **Fig. 30**



Advantage

1. Occlusion status can be assessed continuously
2. Rapid approach
3. Avoids external scar

Disadvantage

1. Only labial cortex of the mandible is visualized. It is possible to have a significant gap in the lingual cortex.
2. Contracture of the vestibule

Complications

1. Mental nerve damage.
2. Lip ptosis and lip ectropion

2. TRANSBUCCAL ACCESS (TROCAR TECHNIQUE)

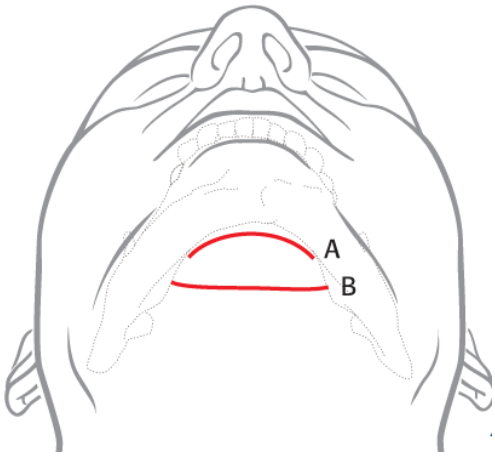
It is a combination of both intraoral and extra oral access. Trocar and specific instruments are used to place the screw. This access is used for body and angle fractures.

EXTRA ORAL ACCESS

A. SUB MENTAL APPROACH

This approach gives good exposure of symphyseal, parasymphyseal and anterior body regions.

Fig. 31



Advantage

1. Mentalis muscle is not divided.
2. Mental nerve is well protected.

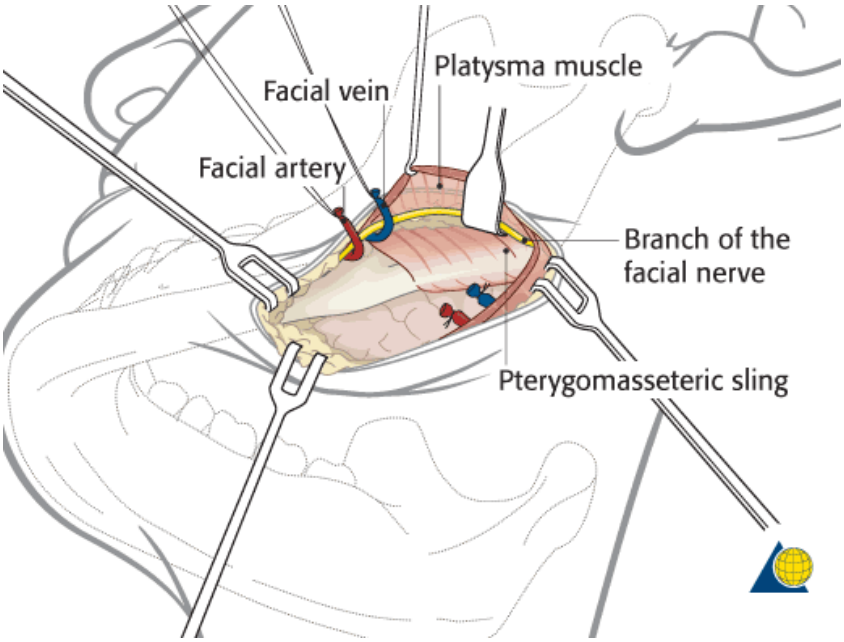
Disadvantage

External scar is present

B. SUB MANDIBULAR APPROACH (RISDON)

It is a 2 to 4 cm curved incision placed 2 cm below the inferior border of the mandible. Marginal mandibular nerve should be identified and protected. Attachment of the masseter muscle at the inferior border is divided and elevated. It gives good exposure to angle, ramus, mid body and particularly in comminuted fractures. This approach is also used in subcondylar fractures.

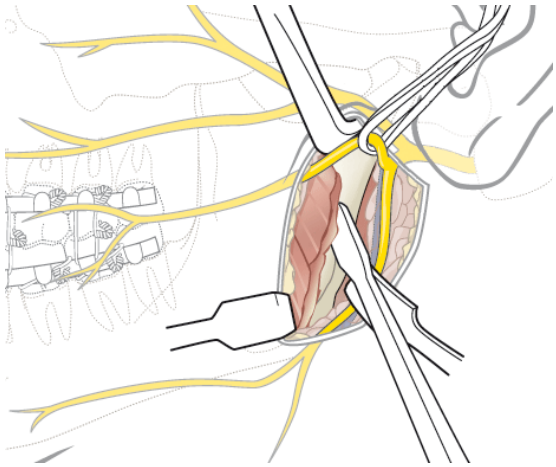
Fig. 32



C. RETRO MANDIBULAR APPROACH

An incision is made 1-2 cm posterior to the border of mandible. It gives exposure to angle, ramus and posterior body regions. Injury to Greater auricular nerve should be avoided.

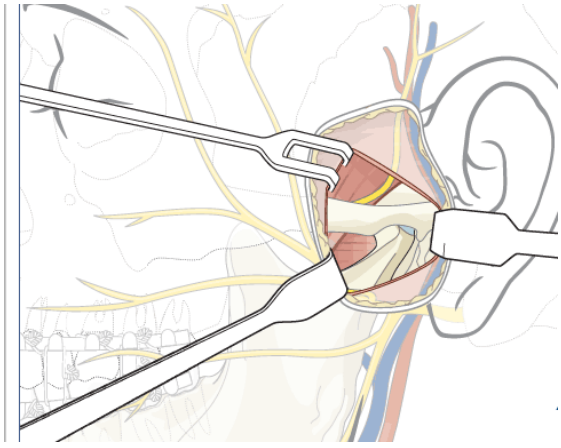
Fig. 33



D. PRE AURICULAR APPROACH

Used to expose condylar head and tempero mandibular joint .Facial nerve should be protected.

Fig. 34



E. POST AURICULAR APPROACH

Used for high condylar fractures

F. TRANS PAROTID APPROACH

This has been described for subcondylar exposure with dissection in the direction of facial nerve fibers to expose the bone through the parotid gland.

Advantage - It is directly over the fracture site.

Complications

1. Parotid fistula
2. Facial nerve injury

MANAGEMENT OF TEETH IN THE FRACTURE LINE

The problem in mandibular fracture management is dealing with teeth in the line of fracture. Commonly, there are impacted third molar associated with mandibular angle fractures. However, any fracture involving the dentate areas of the mandible has the chance to involve erupted teeth in the fracture line.

The surgeon can either remove the involved tooth or leave it in place if it is thought not to compromise the result of fracture management.

Indications for removing the teeth in the line of fracture

1. Tooth subluxated from its socket and interfering with reduction of the fracture.
2. Fractured tooth .
3. Tooth with advanced dental caries carrying a significant risk of abscess during treatment.

4. Tooth with advanced periodontal disease with mobility which could not contribute to the establishment of stable occlusion.
5. Tooth with existing pathology such as cyst or pericoronitis.

Indications for leaving the teeth in the line of fracture

1. Tooth not interfering with the reduction and fixation of fracture.
2. If tooth removal requiring removal of excessive amount of bone, it will lead to compromise in the fracture fixation.
3. Tooth that is in good condition and assists in establishing occlusion and reducing the fracture.

COMPLICATIONS

1. MALOCCLUSION

Malocclusion is the most common complication and functional problem.

Causes of malocclusion are

1. Inaccurate alignment in initial reduction (poorly applied MMF)
2. severe comminution
3. Patient's non compliance.

Minor malocclusion can be corrected with occlusal splints. Severe malocclusion has to be corrected by refracturing or osteotomy and plates osteosynthesis with MMF.

2. DELAYED OR NON UNION

Delayed union is more commonly due to inadequate reduction and fixation. If a fibrous union is present , the fracture will heal with bony consolidation over a period of time .

Non union occurs due to

1. Infection
2. Inadequate opposition of bone.
3. Severe comminution with gap
4. teeth in the fracture line

It has to be treated by re exploration and fixation with bone grafts.

3.MALUNION

Bone heels in abnormal position due to inadequate reduction and fixation. Malunion has to be treated with osteotomy and re fixation with bone graft.

4.INFECTION

Infection is seen in compound fractures, excessive periosteal stripping, unstable fracture fixation and poor oral hygiene. It is treated with culture specific antibiotic, re exploration, removal of devitalized bony fragments and if the fixation is loose do a stable rigid fixation and bone grafting of mandible. If the primary fixation is stable allow it till fracture union.

5. EXPOSED OR LOOSE HARDWARE

Hardware get exposed when there is infection, wound contracture and when a dental prosthesis is worn over hardware. Minor exposure is managed conservatively till fracture union whereas major exposure requires hardware removal and more stable fixation.

6. SENSORIMOTOR DISTURBANCES

Sensory disturbances of inferior alveolar nerve and mental nerve can occur. Motor disturbances due to injury to marginal mandibular nerve and facial nerve have been reported.

7.EXACERBATION OF DENTAL DISEASE

If oral hygiene is not maintained there can be exacerbation of existing dental disease like caries .

8.TEMPOROMANDIBULAR JOINT DYSFUNCTION

Prolonged immobilization with MMF can lead to TMJ dysfunction. Simple jaw exercises and mechanical exercises can improve the condition. Myositis ossificans can occur when hematoma in the muscle organises and ossifies. The myositis has to be excised, but there is a chance of recurrence.

9. SCARS

Unsightly scar can occur in compound fractures. It can be managed initially with scar massaging followed by scar revision .

MATERIALS AND METHODS

This study was conducted in the Department of Plastic and Reconstructive Surgery, Coimbatore Medical college and Hospital ,Coimbatore on 67 patients who reported to the trauma ward and the department of plastic and reconstructive surgery for the treatment of fracture mandible from December 2012 to December 2014.

Before the start of the study, ethical clearance was obtained from the Ethical committee of the Coimbatore Medical College and Hospital, Coimbatore. Informations were collected from the clinical and surgical notes of each of the patients in a standardized and systematic pattern. The demographic variables such as age, gender, and residence were assessed. Clinical information included diagnosis, etiology, and anatomical distribution of mandibular fractures was assessed.

The mandibular fractures were classified according to the sites such as ramus, Condyle, Coronoid Symphysis, body, Parasymphysis and angle.

INCLUSION CRITERIA

1. All adult patients between 25 to 55 years.
2. Patients reporting within first 7-10 days from the day of trauma.
3. Dentulous / partially dentulous patients
4. Patients giving consent for a follow up period of 3 months post operatively.

EXCLUSION CRITERIA

1. Compound fractures
2. Patients with other facial bone fractures.
3. Patients with systemic / debilitating diseases
4. Patients with head injury

CLINICAL EVALUATION

1. History of incident
2. Inspection- swelling , laceration ,malocclusion, sublingual hematoma, deformity and trismus
3. Palpation-step deformity/tenderness
4. Paresthesia / dysaesthesia/ anesthesia of mental nerve.
5. TMJ examination- to find any Condyle fracture.

All patients with suspected mandible fracture were subjected to OPG (Orthopantomogram) & CT facial bones .The mandibular fractures were classified according to the site such as Ramus, Condyle, Symphysis, Body, Parasymphysis and Angle. All these patients were transferred to the Plastic surgery ward.

Out of 67 patients ,15 patients who had undisplaced fractures , Condylar & Subcondylar fractures were treated conservatively with arch bars , eyelets and Maxillomandibular fixation **(MMF)** for 4 -6weeks .They were done under mandibular nerve block in our ward within 24-48 hours. Post MMF OPG was taken to assess the reduction .These patients were started on liquid diet soon after the MMF and

encouraged to maintain oral hygiene The remaining 52 displaced ,unfavorable and Communited fractures were treated surgically .

Arch bars and MMF were done preoperatively for all the cases to achieve conclusion. Extra oral approach (Risdon) was used for the angle fracture . Intra oral approach (gingivobuccal sulcal approach) was used for the Symphysis, Parasymphysis and body the fractures.

Surgical technique

All the 52 patients who were taken up for surgery were treated according to the principles outlined by Champy. Conventional non locking miniplates and screws were used.

Taking into account the anatomy of the mandible, with the location of the dental apices and the thickness of the cortical layer, Champy et al determined an ideal line of osteosynthesis which corresponds to the course of a line of tension at the base of the alveolar process.[15,16]

As Champy recommended , one plate was applied behind the mental foramen, just below the dental roots and above the inferior alveolar nerve, in order to neutralize the higher torsion forces between the canines. A second plate was applied near the lower border of the mandible in addition to the sub-apical plate. In the miniplate system unicortical fixation was done.

INSTRUMENTS

Fig. 35

Fig. 36

ANESTHESIA AND PREPARATION OF SURGICAL SITE

All cases were treated under general anesthesia with nasotracheal intubation in supine position . Extra-oral scrubbing was done with povidone-iodine. The oral cavity was prepared with diluted povidone- iodine. Towels and drapes were applied to expose the mouth and neck. 2% Lignocaine with 1: 1,00,000 adrenaline was used for infiltration.

SURGICAL PROCEDURE

INCISION:

The fractures of the Parasymphysis, Symphysis and body were exposed using lower gingivobuccal sulcus approach. A low level vestibular incision was made just near the fracture site and a mucoperiosteal flap was raised to expose the fracture site till the lower border of the mandible. Great care was taken not to damage the mental nerve. For angle fractures Risdon approach was used . Marginal mandibular nerve was identified and protected.

REDUCTION

All single fractures , a preinjury occlusion was achieved with pre operative Maxillomandibular fixation (MMF) and then the fracture was fixed. In cases of comminuted fractures , fracture site was exposed intraoperative fracture reduction was done and occlusion was maintained with MMF and then fracture was fixed with plate and screws.

We used 2mm conventional miniplates and 2x8 mm screws for fixation.

In placing the hole, the drill was made perpendicular to bone surface and plate within the centre of the screw hole, with 701 or 702 bur, so that the screw gets fitted into bone plate.

Two four hole conventional miniplates were used in the Symphysis and Parasymphysis fractures between the mental foramina according to Champy's line of osteosynthesis.

These lines corresponds to the

1. Course of a line of tension at the base of alveolar process and
2. Another line near the lower border of the mandible in order to neutralize torsion forces.

A gap of 4-5mm and parallelism were maintained between the two plates. The upper plate was fixed first and then the lower plate with 2x8 mm screws on either side of the fracture. Care was taken not to injure the nerve in the mandibular canal. Marginal mandibular nerve was protected during the Risdon approach. The occlusion was checked and the screws were tightened finally. Maxillomandibular fixation was released depending on the stability of the fixation.

In cases where 2 miniplates were used, MMF was removed soon after the surgery . In cases where single plate was used, MMF retained for 2 wks. Arch bars maintained for 4 more wks. In fractures with combinations like Parasymphysis and Subcondyle, plating was done only for the Parasymphysis and the Subcondyle treated conservatively with MMF for 2-3 weeks .

CLOSURE

The fracture site was irrigated and soft tissues closed with 2-0 vicryl in two layers. Post operative OPG was taken to assess the stability of fixation.

POSTOPERATIVE CARE

All patients were kept under antibiotic cover for 5 days. Those for whom MMF was removed they were advised to take liquid diet for 2days and thereafter on a soft diet for 4to 6 weeks. Those who were advised to maintain MMF , continued liquid diet for 2-3 weeks .

The patients were asked to maintain oral hygiene with mouth wash. Sutures were removed on the 5^{th} postoperative day for patients who had underwent extra oral approach.

At the end of second post operative week they were started on gentle physiotherapy. Follow up was performed weekly during the first 6 weeks and thereafter monthly for 4 to 6 months.

FOLLOW UP

During the immediate follow up the following parameters were recorded.

1. Resolution of facial edema.
2. Healing of surgical sites.
3. Sensory , motor disturbances.
4. Visual analog score for pain
5. Visual analog score for chewing ability

6. Angle criteria for occlusion
7. Mouth opening
8. Weight loss

Data in the form of two Visual Analogue Scales (VAS) related to the degree of pain and dysfunction in terms of chewing capabilities were collected.[68]

VISUAL ANALOGUE SCALES

Pain is a subjective experience reported by the patients . In clinical pain research, pain is usually measured in rating scales . There are various rating scales have been used like visual, verbal and numerical in clinical setting. The visual analogue scale (VAS) for pain assessment was studied **by Huskisson** .

A commonly used visual analogue pain scale consists of a 100mm line, anchored at each end with terms describing the amount of pain felt (for example: "No pain" to "worst pain possible"). The subject makes a mark on the line corresponding to the amount of pain felt, and the distance from the "No pain" end of the scale to the marked point is measured in millimeters (mm). Thus visual analogue scale provides data on pain in the form of a continuous variable. The other rating scale uses the verbal descriptor as 'none' , 'mild' , 'moderate' and 'severe'.

In our study we used the following:

VAS I was used to assess the level of pain (ranging from 0 to 10). VAS II was used to assess the level of disturbance in jaw function (ranging from 0 to 10).

Patient were given a chart with numerical marked from 0 to 10 making it more simpler for the patient to express their subjective ratings of pain and dysfunction (chewing capability).

VISUAL ANALOGUE SCALE – I (FOR PAIN)

0 – No pain

2 – Annoying pain

4 – Uncomfortable pain

6 – Dreadful pain

8 – Horrible pain

10 – Agonizing pain (most intense pain imaginable).

VISUAL ANALOGUE SCALE – II (FOR CHEWING ABILITY)

0 – No impairment

2 – Mild impairment

4 – Moderate impairment

6 – Severe impairment

8 – Very severe impairment but able to chew

10 – Total inability to chew.

Patients were explained about the chart and were asked to mark the level of their rating in both the scales.

OBSERVATION AND RESULTS

The total number of patients who underwent treatment for both conservative and surgically treated patients were sixty seven. The number of patients in the conservative group was fifteen and surgically treated was fifty two.

TABLE - 1. AGE DISTRIBUTION OF MANDIBLE FRACTURES

Age	Conservative	Surgical
25-30	6	25
31-35	1	10
36-40	3	10
41-45	0	3
46-50	4	3
51-55	1	1
Total	15	52

In this study both in conservative and surgical majority of the injured patients were in the age group between 25-30 (42.6%). The youngest patient was 25 years and the oldest was 54 years. About 55 patients (82%) were in the age group of 25-40 years .

GENDER DISTRIBUTION

Fig. 37

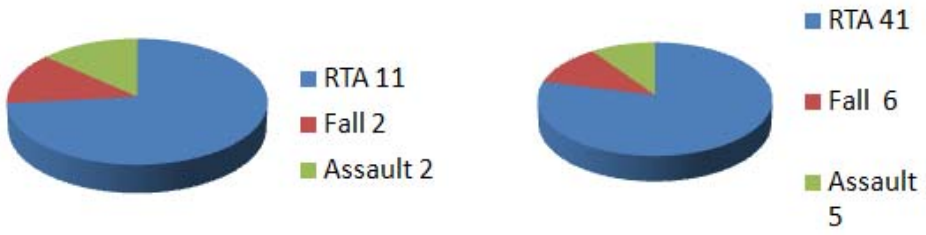
Conservative **Surgical**

Of the 15 patients treated conservatively all were male and in the 52 patients treated surgically 43 were male (82.6%) and 9 were female .

MODE OF INJURY

Fig. 38

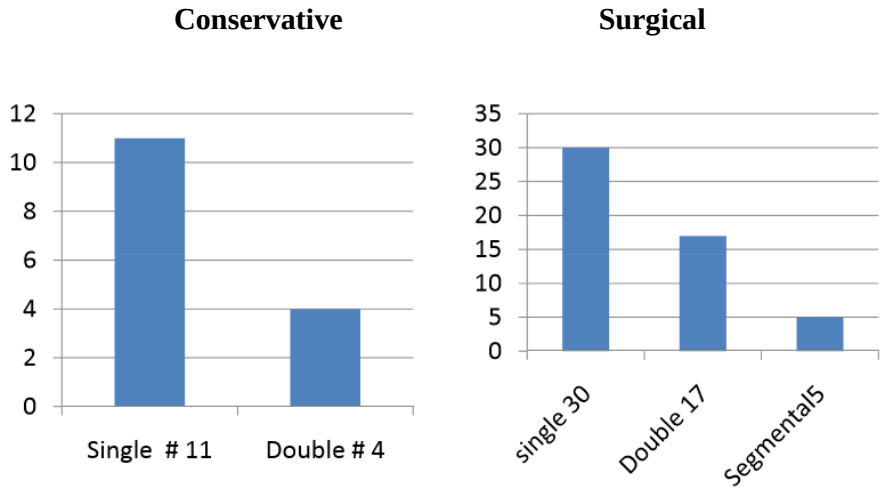
Conservative **Surgical**



Road traffic accident (RTA) was the most common mode of injury in both conservative and surgically treated patients, which was followed by fall and assault . Road traffic accident was about 76.6% in both the groups (67 patients).

NUMBER OF FRACTURES

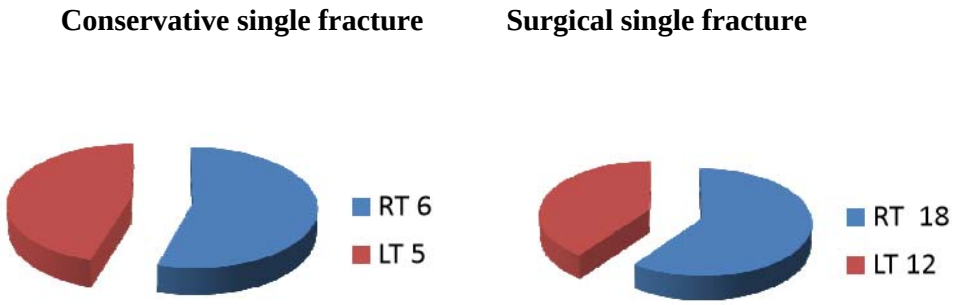
Fig. 39



Of the 15 patients treated conservatively 11 (73.3%) had single fracture and 4 (26.6%) had double fractures. In the surgically treated patients 30 (57.6%) had single fracture , 17 (32.6%) had double fractures and 15 (28.8%) had segmental fractures.

SIDE OF INJURY

Fig. 40

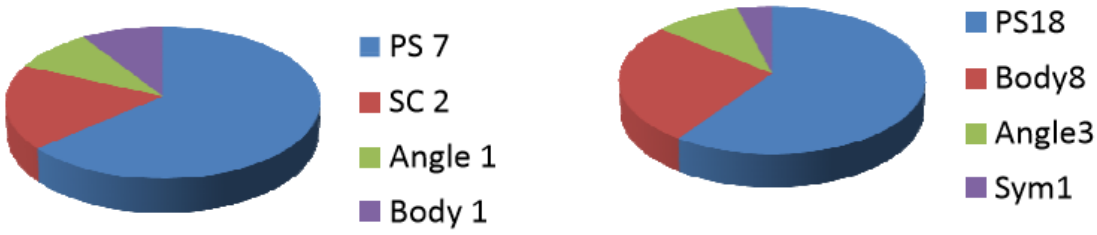


In single fracture right side (58.5%) was the most frequently involved.

FRATURE DISTRIBUTION IN SINGLE FRACTURE

Fig. 41

Conservative **Surgical**



PS-Parasymphysis

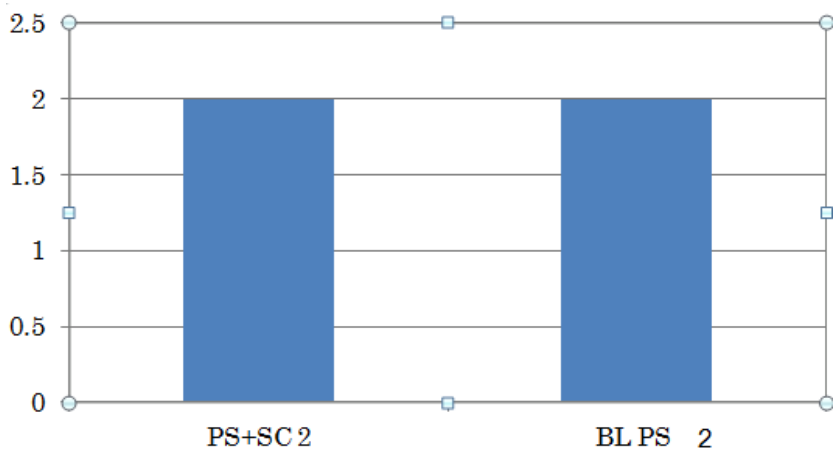
SC-Sub condyle

Sym-Symphysis

In both the groups Parasymphysis (48%) was the most common site of involvement in single fracture.

CONSERVATIVE DOUBLE FRACTURE

Fig. 42



PS-Parasymphysis

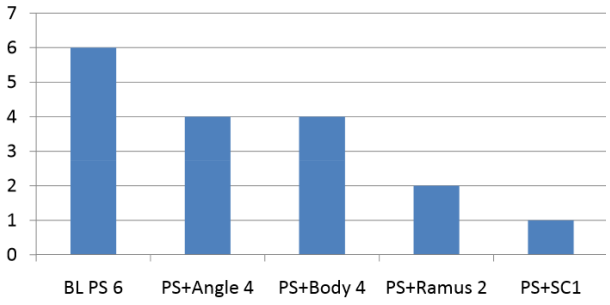
SC-Sub condyle

BL-Bilateral

The combinations in conservative double fractures were Parasymphysis with subcondylar and bilateral Parasymphysis fracture.

DOUBLE FRACTURE SURGICAL

Fig. 43



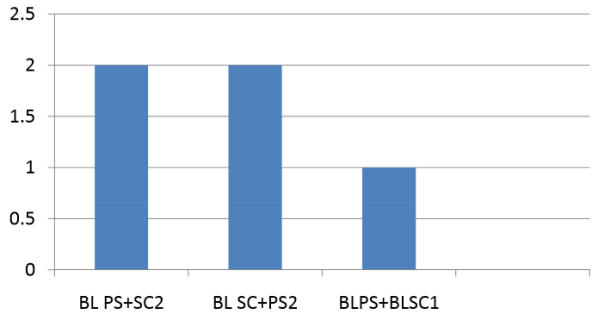
BL- Bilateral
PS- Parasymphysis
SC-Subcondyle

In surgically treated double fractures the following were the combinations .

Bilateral Parasymphysis -6, Parasymphysis with Angle - 4, Parasymphysis with Body - 4, Parasymphysis with Ramus - 2 and Parasymphysis with subcondylar -1. Bilateral Parasymphysis was the most common fracture . All the combinations had Parasymphysis fracture.

SEGMENTAL FRACTURE SURGICAL

Fig. 44



BL-Bilateral
PS-Parasymphysis
SC-Subcondyle

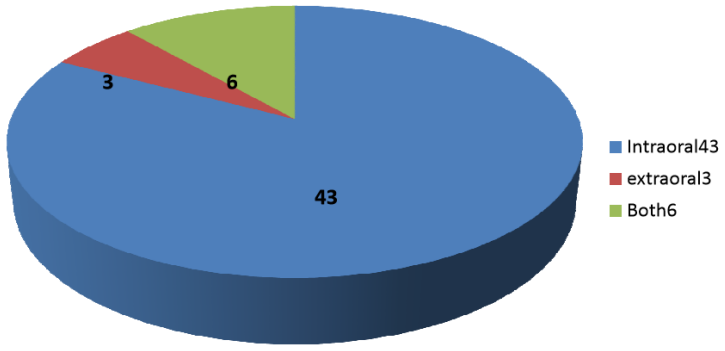
There were five cases of segmental fracture. Of which bilateral Parasymphysis with Subcondylar-2, bilateral subcondylar with Parasymphysis -2 and bilateral Parasymphysis with bilateral subcondylar fracture-1.

TIME INTERVAL BETWEEN INJURY AND PROCEDURE

In the patients treated conservatively, Maxillomandibular fixation (MMF) done within 24-48 hours. In the surgically treated patients , operated in an average period of 7 days.

SURGICAL APPROACH

Fig. 45

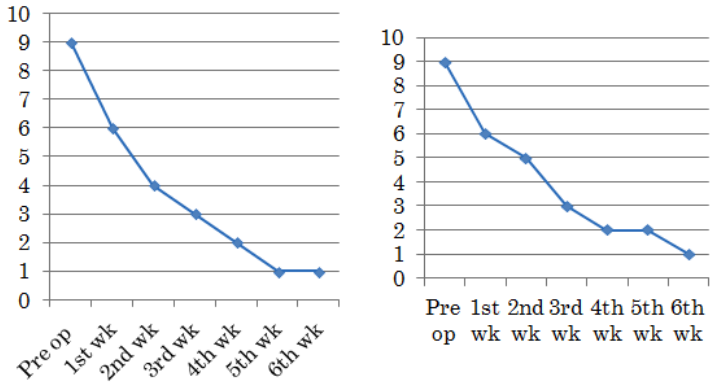


Out of the 52 patients treated surgically, 43 patients underwent intraoral approach ,3 patients underwent extra oral approach (Risdon approach) and 6 patients underwent both the approaches.

VISUAL ANALOG SCORE FOR PAIN

Fig. 46

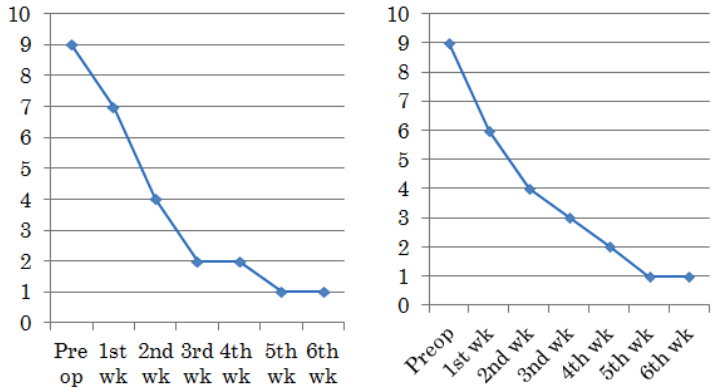
Conservative single fracture **Conservative double fracture**



In both single and double fractures treated conservatively the prefixation score of 9 improved to 1 by the end of five weeks in single fractures but it took one more week in double fracture.

Fig. 47

Surgical single fracture **Surgical double and segmental fracture**

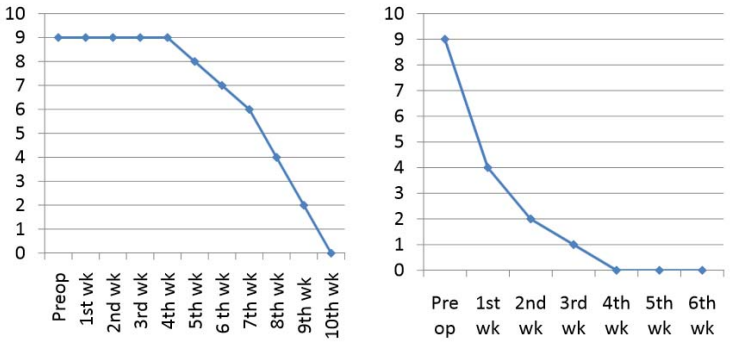


In surgically treated patients (single, double and segmental fractures) the results were same as conservatively treated single and double fractures, but the pain score was remaining high in the second and the third weeks.

VISUAL ANALOG SCALE FOR CHEWING

Fig. 48

Conservative **Surgical**



In the conservative group the visual analog score for chewing improved from 9 to 6 in 6 weeks time and in the surgical group the score improved in 4 weeks time, since we removed Maxillomandibular fixation (MMF) soon after surgery

MOUTH OPENING

Table. 2

Conservative	Surgical
Single fracture - 45-50 mm	Single fracture - 45-50mm
Double fracture - 40- 45mm	Double fracture- 40-45mm
	Segmental fracture - 40-45mm

The mouth opening become near normal(45-50mm) in single fractures both in conservative and surgical groups. In double fractures of both the group the mouth opening was 40-45mm in six weeks time

OCCLUSION

Angle Class I occlusion was achieved in 13 patients (86.6%) in conservatively treated patients and 49 patients (94.2%) in surgically treated patients. There were 2 cases of open bite (13.3%) in conservatively treated patients and 3 cases of open bite (5.7%) in surgically treated patients .

COMPLICATIONS

Table.3

S.no	Complications	Conservative	Surgical
1	Mal occlusion	2 (13.3%)	4 (7.6%)
2	Infection	0	5 (9.6%)
3	Non union	0	0
4	Mal union	1% (6.6%)	0
5	Paresthesia-Mental nerve involvement Marginal mandibular nerve involvement	2 (13.3%) -	4 (7.6%) 0
6	Hard ware exposure	0	0

DISCUSSION

The mandible although considered the heaviest and the strongest facial bone, is more prone for fractures because it is an open arch, located in the lower portion of the face and atrophies with age. Facial injuries not only involves soft tissues but also damages the bone, leading to fractures. Mandible is connected by strong muscles for various functions .They act as a splint and give protection to the mandible, on the other hand these powerful muscles can cause massive displacement of the fracture fragments.[68]

The human face constitutes the first contact point in several human interactions thus, injuries and mutilation of the facial structures may have a disastrous influence on the affected person.[84] Knowledge of the dentition is thus an absolute prerequisite for the proper treatment of mandible fractures. Fractures of the mandible invariably produce malocclusion if not treated properly.

The most common facial fractures were the mandible (61%), followed by the maxilla (46%), the zygoma (27%) and the nasal bones (19.5%).[57,58]

Road traffic injury was the most common mode of injury in our study (76.6%) followed by fall and assault. **Adekeye** has reported that 74% of mandibular fractures were due to road traffic accidents.[1,58] This was also reported by **Subhashraj et al** in a study done in South Indian city.[71] The mechanism of hyperextension and hyper flexion of the head in traffic accidents makes it more vulnerable to fracture [34].

Males are predominantly involved in mandibular fractures [43,52,74]. This male predominance may be due to the greater mobility of the male and their aggressive behavior. In our study we found that the **age group** between 25-30 years was the most commonly involved . This was supported by **Ajmal et al [3]** and **Wimon Sirimaharaj et al [70].**

There were 61.6% of single mandibular fractures and 40.6% of multiple mandibular fractures, with an average of 1.34 fractures per person. This is similar to that of **Sirimaharaj et al.[70]** who reported 1.4 fractures per person **. Ajmal et al [3]** reported 1.5 fractures per person.

Parasymphyseal fractures were the most common fractures in our study followed by body and angle. [52] Among double fractures the most common combination is bilateral Parasymphysis. In segmental fractures, bilateral Parasymphysis fracture was the most common one. Right side involvement was common. **Ajmal et al [3]**also reported Parasymphyseal fractures were the most frequently involved followed by body and angle **.**This was also supported by **Mittal et al [52]** study**.**

Deranged occlusion followed by bony deformity was the commonest mode of clinical presentation .This finding was supported by **Laurentjoye M et al.[46]**

All the Parasymphysis ,Symphysis and body fractures were approached intra orally. Extra oral approach was used for angle fractures. Care was taken not to injure the mental nerve during intraoral and marginal mandibular nerve during Risdon approach.

In our study, undisplaced fractures, condylar and subcondylar fractures were treated with Maxillomandibular fixation (MMF). with good functional results as comparable with **Ghodke et al.**[31]

Out of 67 patients 15 (22.3%) underwent conservative treatment with eyelets ,arch bars and Maxillomandibular fixation (MMF). The duration of MMF was 4-6 weeks in adults, 2-3 weeks in condylar fractures [4]. **Benjamin et al** [10] study from Nigeria have also reported the usage of arch bars and eyelets with same results.

The average recommended period of immobilization of fractured mandible is 4-6 weeks.[27,43,57]Although this is only empirical, it is usually influenced by several factors such as age of patient, type, number and severity of fracture, presence or otherwise of retained teeth in fracture line, and presence or absence of infection amongst others.[52]

In both the conservative & surgical single fracture patients , the visual analog score - pre operative pain score of 9 has come down to 1 during 5th week.

In surgical group the pain score was remaining high in the 1st week due to surgical trauma ,then it has reduced to 2 during 3rd week due to stability of fixation. In surgical double fracture the pre operative pain score of 9 has come down to 1 in 5 weeks . But it took 1 more week for the conservative double fracture to come down to one .

In conservative group the pre operative chewing score improved from 9 to 0 in ten weeks. In the surgical group it improved from 9 to 0 in 4-6 weeks . After removal of the MMF (6 weeks) in the conservative group and in the 3rd post operative week in surgical group, patients were encouraged to do early physiotherapy. They had impairment in speech also in conservative group. At the end of 3 months none of the patients had mastication and speech problem , which was comparable with **Shivani et al.**[68]

The average mouth opening was 41.5 mm in the conservatively treated group and 47 mm in the surgically treated group. This was probably due to the TMJ dysfunction in the conservatively treated group in whom MMF was retained for 4-5 weeks . This was comparable with studies done by **Amarathunga NA**[4] **and Cawood et al** [13] . This probably due to the muscle disuse atrophy and scarring in the fracture site following tissue disruption and haematoma formation.[69] Near normal opening in the surgical group due to MMF removal after surgery and early mobilization.

There was weight loss, air way related problem , difficulty in phonation and poor oral hygiene in the conservatively treated group. Weight gain and good oral hygiene was seen in the surgically treated patients. This study was similar to that of **Brown.J.S. et al.**[12] who demonstrated the advantages of miniplate osteosynthesis over intermaxillary fixation in management of fractured mandible. The post operative function is improved and there was weight gain . Patient treated with intermaxillary fixation have restricted airway .

There was weight loss during the first postoperative week in surgically treated patients. This was probably due to the poor intake of proper diet due to surgical trauma.

Complications

Two patients (13.3%) had **malocclusion** in the conservative group ,which was noticed in the first review and they were subjected to open reduction . There was malocclusion in four patients (7.6%) who were treated surgically which were less when compared with the **Benjamin et al** [10]study. All the four patients were subjected to redo and occlusion was achieved.

There were five cases of **infection** (9.6%) in the operated group which were treated with higher antibiotics and the implant was retained till the fracture union . Implant removal was done in all these five patients after the fracture union . The infection rate was little higher when compared to **Ugboko et al.**[57] who had 8.1%. One patient who was treated conservatively developed **malunion** and it was corrected with osteotomy ,bone graft and plate osteosynthesis.

The **neurological deficit** in the operated group was 4 (7.6%) and the conservative group was 2 which was comparable to the study done by **Okoturo and Benjamin et al**.,[10] (7.1%) and **Cawood** [13] (8%) which improved in 6-8 weeks time . This deficit was not due to the surgical procedure but related to the nature of injury.

CONCLUSION

The treatment of mandible fractures requires adequate fracture reduction and stabilization through a closed or open technique. Success relies on the restoration of normal dental occlusion and bony union. The treatment chosen may differ as there are many factors like cost of treatment, affordability by the patient, feasibility in the hospital, doctor's decision and skill, and patient's willingness to avail the treatment advised; all of which may vary from one country to another.

This study is not comparing the results of closed reduction and open reduction techniques. It is an analysis of the mandibular fracture demographic variables and outcome of the management adopted in patients presented to our department. The results of the patients treated both closed and open methods were same as reported in the literature.

In single fracture, the results both in the surgical and conservative groups are equal.

Conservative group took longer time for improvement than surgical group, since we maintain MMF for 4-6 Weeks.

In double and segmental fracture, surgical management had good outcome with double plate fixation.

Intra osseous wiring prevented distraction; however, it does not provide sustained inter fragmentary compression.[69] This has led to increased preference for open reduction and internal fixation with miniplates. This has helped reduce malocclusion, nonunion, improved mouth opening, speech, decreased weight loss, and increased the ability for patients to return to work earlier.[69]

High levels of success can still be achieved using available materials in the form of arch bars, eyelets and wire osteosynthesis in the treatment of mandibular fractures using either the closed or open reduction technique in resource poor settings despite the advent of miniplate osteosynthesis.

CONSERVATIVE CASE No.12

RIGHT PARASYMPHYSIS FRACTURE

PRE MMF

POST MMF

CONSERVATIVE CASE No.11

LEFT SUBCONDYLAR FRACTURE

PRE MMF

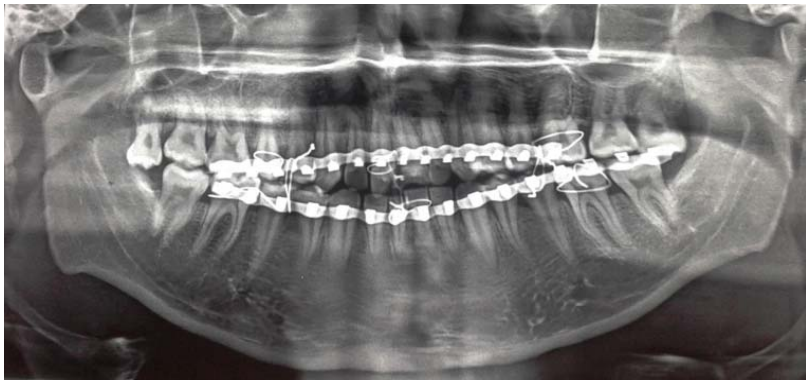
POST MMF

CONSERVATIVE CASE No.8

BILATERAL SUBCONDYLAR FRACTURE

PRE MMF

POST MMF



OPEN BITE

SURGICAL CASE No.42

LEFT ANGLE FRACTURE

PRE OP

POST OP

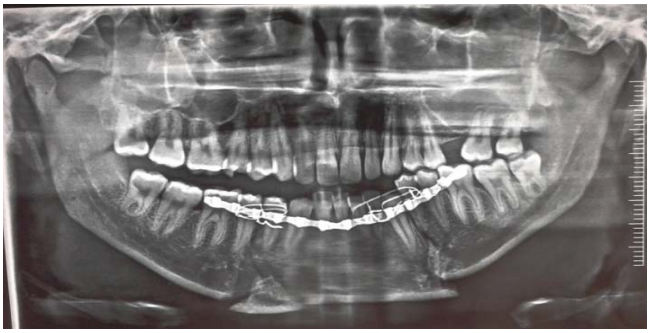
PER OP

POST OP CLINICAL PICTURE

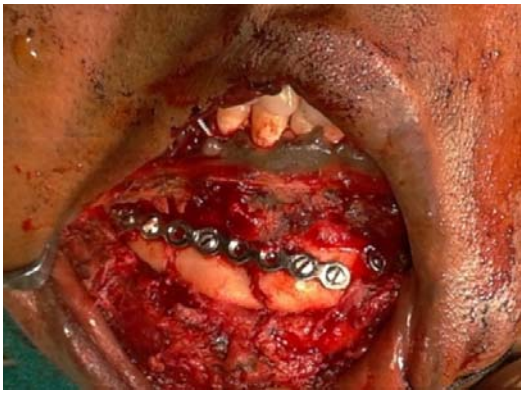
SURGICAL CASE No. 13

BILATERAL PARASYMPHYSIS FRACTURE

PRE OP



PER OP



POST OP

SURGICAL CASE No. 8

RIGHT BODY FRACTURE

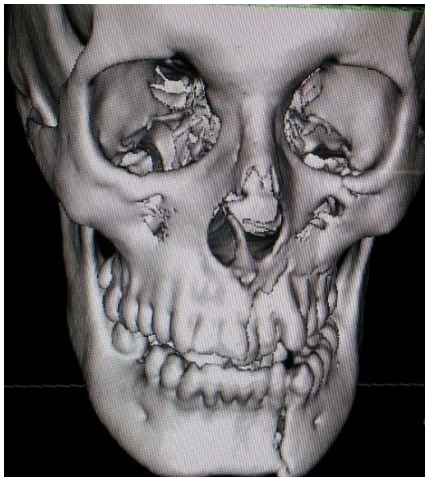
PRE OP

POST OP

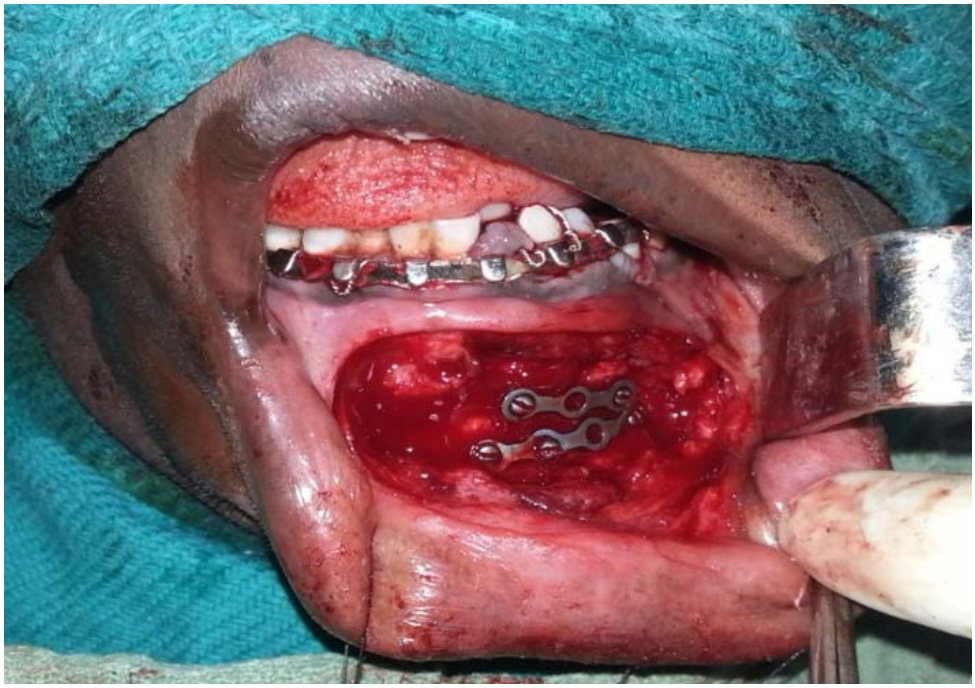
SURGICAL CASE No. 6

LEFT PARASYMPHYSIS FRACTURE

PRE OP



PER OP

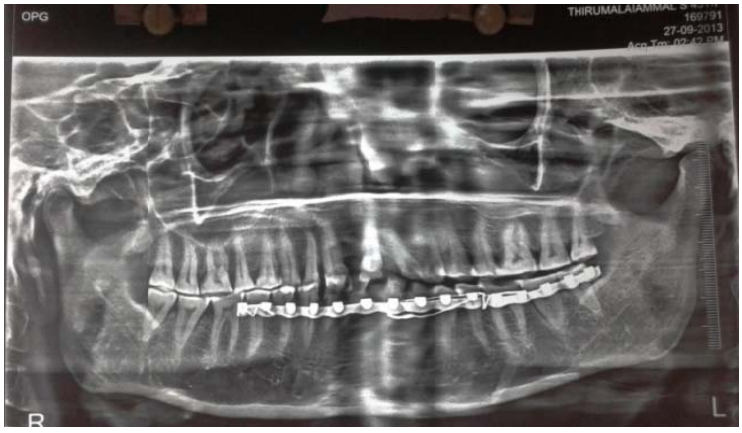


COMPLICATIONS

SURGICAL CASE No. 40

INFECTED IMPLANT

POST OP (AFTER METAL EXIT)



MALUNION

CONSERVATIVE CASE No. 14

LEFT BODY FRACTURE – went into malunion – osteotomy, plating and bone grafting

PRE OP

POST OP

BIBLIOGRAPHY

1. Adekeye EO. The pattern of fractures of the facial skeleton in Kaduna, Nigeria. A survey of 1,447 cases. Oral Surg Oral Med Oral Pathol 1980;49:491‑5.
2. Adewole RA. An audit of mandibular fracture treatment methods at a Military Base Hospital Yaba, Lagos Nigeria: A 5‑year retrospective study. Nig J Clinical Pract 2001;4:1‑4.
3. Ajmal S, Khan MA, Jadoon H, Malik SA. Management protocol of mandibular fractures at Pakistan Institute Of Medical Sciences, Islamabad, Pakistan. J Ayub Med Coll Abbottabad 2007; 19(3): 51-55.
4. Amartunga NA. Mouth opening after release of maxillo- mandibular fixationinfracture patients. J Oral Maxillofac surg 1987;45:383-85
5. Andres. J.J. Gonzalez et al., “Evaluation of Trismus after treatment of mandibular fractures”. J-Oral-Maxillofac-Surg. 1992; 50 : 223-228.
6. Ayman Chritah, Stewert .K. Lazaro, Julius. R. Berger.,“Transoral 2.0mm locking miiniplate fixation of mandibular fractures plus I week of maxsillomandibular fixation : a prospective study”. Journal of Oral and Maxillofacial Surgery. 2005;63: 1737-1741.
7. Bank P. Killey’s fractures of the mandible. 4th ed. Oxford: Wright Butterworth‑Heinemann Ltd; 1991. p. 192‑216.
8. Barrera JE, Stephen GB, Hassan HR. Fractures of the mandibular angle. e‑medicine.com, Inc. 2006;1‑12.
9. Barton JR. A systemic bandage for fractures of the lower jaw. Am Med Recorder Phila. 1819;2:153.

10. Benjamin A, Sara KE, Olushola AI. Analysis of complication of mandibular fracture. Afr J Trauma 2014;3:24-9
11. Bjorn Johnston, Leonard Krukmenov.,“Minplate osteosynthesis in infected mandibular fractures”. Journal of Cranio Max Facial Surgery 1998; 16:22-27.
12. Brown. J.S et al., “The fate of miniplates in facial trauma and orthognathic surgery: a restrospecitve study”. Br. J Oral Maxillofac Surg 1989. 27 (4); 306 - 315.
13. Cawood JI. Small plate osteosynthesis of mandibular fractures. Br J Oral Maxillofac Surg 1985;23:77‑91.
14. Chu L, Gussack GS, Muller T. A treatment protocol for mandibular fractures. J Trauma 1994;36:48‑52.
15. Champy M, Loddé JP, Schmitt Spiessl B. Rigid internal fixation of fractures of the lower jaw. Reconstr Surg Traumatol. 1972;13:124-40. [Medline].
16. Champy.M, et al., “Mandibular osteosynthesis by miniature plates via a buccal approach”. J Oral Maxillofac Surg. 1978; 6: 14.
17. Cienfuegos R, Cornelius CP, Ellis 3rd E, Kushner G. CMF Mandible - Diagnosis - AO Surgery reference. AO Foundation.
18. Danis : Theory and practice of Osteosynthesis Paris, Masson, 1949. 7. 42. Kruger: “Text book of Oral Surgery”, Mosby; 1964.
19. Dimitroulis. G., “Management of fractured mandible without the use of intermaxillary fixation”. J Oral Maxillofac Surg. 2002;60: 1435
20. Edward Ellis et al., “Treatment of mandibular angle fractures using two 2.4 mm dynamic compression plates”. J Oral Maxillofac Surg. 1993 ; 51: 969-973.
21. Edward Ellis et al., “Treatment of mandibular angle fractures using two noncompression miniplates”. J Oral Maxillofac-Surg. 1994 ;52(10): 1032-6

22. Edward Ellis III et al., “Use of a 2 mm locking plate/screw system for mandibular fracture surgery” .J Oral Maxillofac Surg. 2002: 60 : 642-645
23. Edwards T.J et al., “The relationship between fracture severity and complication rate in miniplate osteosynthesis of mandibular fractures”. Br J Plast Surg.1994;47(5):310-1.
24. Ellis E 3rd, Moos KF, el-Attar A. Ten years of mandibular fractures: an analysis of 2,137 cases. Oral Surg Oral Med Oral Pathol. Feb 1985;59(2):120-9. [Medline].
25. Ellis III et a!., “Treatment consideration for comminuted mandibular fractures”. J Oral Maxillofac Surg. 2003; 61: 861-70
26. Feller. K et al., “Analysis of complications in fractures of the mandibular angle — a study with finite element computation and evaluation of data of 277 patients”. J. Cranio Maxillo Fac Surg 2003; Oct 31 — 290-5 .
27. Fonseca RJ, Bruce R, Walker R. Trauma. Oral and Maxillofacial Surgery. Washington manual. Vol. 1. 2001. p. 19‑34.
28. Fordyce.A.M et al., “Intermaxillary fixation is not usually necessary to reduce mandibular fractures”. J Oral Maxillofac Surg. 1997 : 52-57
29. Fuselier et al., “Do mandibular third molar alter the risk of Angle fracture”. J Oral Maxillofac Surg. 2002; 60: 514-518.
30. Gerbino.G et al., “Rigid fixation with teeth in the line of mandibular fracture”. Int J Oral Maxillofac. Surg. 1997 ; 26: 182-186.
31. Ghodke MH, Bhoyar SC, Shah SV. Prevalence of mandibular fractures reported at C.S.M.S.S Dental College, Aurangabad from February 2008 to September 2009. J IntSoc Prevent Communit Dent 2013;3:51-8.

32. Gregory. S. Tate et al.,: “Bite forces in patients treated for mandibular angle fractures : Implications for fixation- recommendations.” J Oral Maxillofac Surg. 1994; 52 : 734-736.

33. Grunst. J., “Interference with bone blood supply through plating, of intact bone. Current concepts in the internal fixation of fractures.” 1980. .

34. Holt GR. Maxillofacial trauma. In: Cummings CW, Krause CJ, editors. Otolaryngology‑Head and Neck Surgery. St. Louis: C.V. Mosby; 1986. p. 313‑44.

35. James RB, Fredrickson C, Kent JN. Prospective study of mandibular fractures. J Oral Surg 1981;39:275‑81

36. J. Tams, J. P. Vanloon, F.R. Rozeno: “A three dimensional study of loads across the fracture for different fracture sites of the mandible”. British Journal of 0ral and Maxillofacial Surgery. 1996;34: 400-405.

37. J. Tams, J. P. Vanloon: “A three dimensional study of bending and torsion moments for different fracture sites in the mandible: an in vitro study”. International Journal of Maxillofacial Surgery 1997: 26: 383:388.

38. J.P. Hayter, I. Cawood., “ The functional case for miniplates in maxillofacial surgery”. International Journal of Oral and Maxillofacial Surgery. 1993;22: 91-96.

39. J.S. Brown, N. Grew , C. Taylor: “Intermaxillary fixation compared to miniplate osteosynthesis in the management of the fractured mandible: an audit”. British Journal of Oral and Maxillofacial Surgery. 1991; 29:308-311

40. James W. Sikes et al, : “Comparison of fixation strength of locking head and conventional screws, in fracture and reconstruction models”. J Oral Maxillofac Surg. 1998 ; 56: 468- 473

41. Jeffrey. C. Posnick et al., “Pediatric facial fractures”. J OraI Maxillofac Surg.1993; 51: 836- 44
42. K.E. KahnBerg, A. Ridell., “Bone plate fixation of mandibular fractures” International Journal of Oral Surgery 1980; 9:267-273. .
43. Kamali U, Pohchi A. Mandibular fracture at HUSM: A 5‐year retrospective study. Arch Orofacial Sci 2009;4:33‐5.
44. Kazanjian VH, Converse JM. Surgical treatment of facial injuries. 3rd ed. Baltimore: The Williams and Wilkins Company; 1980. p. 66‐8.
45. Kawai. T et al., “Radiographic changes during bone healing after mandibular fractures.” British Journal of oral and maxillofacial surgery. 1997 ; 35 : 312-318.
46. Laurentjoye M et al, Mandibular Fractures With Michelet Technique: Manual Fracture Reduction Without Arch Bars. J Oral Maxillofac Surg. 2009;67:2374-2379.
47. Malik NA. Textbook of Oral and Maxillofacial Surgery. In: 2nd Ed. Applied surgical anatomy of the mandible and classification of mandibular fractures. New Delhi: Jaypee Brothers Medical Publishers; 2008. p. 378‐85.
48. Marisa Aparecida Cabrini Gabrielli, Mario Fransisco Real Gabrielli., “ Fixation of mandibular fracture with 2.0mm miniplates: A review of 191 cases” Journal of Oral and Maxillofacial Surgery. 2003; 61:430-436.
49. Mathod et al., “Non union of mandible - An analysis of contributing factors”. J Oral Maxillofac Surg. 2000; 58 :746 -52.
50. Michelet et al., “Osteosynthesis with miniaturized screwed plates in maxillofacial surgery”. J Oral Maxillofac Surg. 1973; 1: 79.
51. Mitchell. M. Rubin et al., : “Morbidity associated with incompletely erupted third molar in the line of mandibular fracture. J Oral Maxillofac Surg. 1990; 1045-1047. :

52. Mittal G, Mittal SR. Mandibular fractures at veer Chandra Singh Garhwali Government Medical Science and Research Institute, Garhwal region, Uttarakhand, India: A retrospective study. Ann Med Health Sci Res 2013;3:161-5.
53. Monty Reitzik and Willem Schrool., "Bone repair in the Mandible: a histologic and biometric comparison between rigid and semi rigid fixation". Journal of Oral and Maxillofacial Surgery 1983; 215-218
54. Moon H. Mechanical appliances for treatment of fracture of the jaws. *Br J Dent Sci*. 1874;17:303.
55. Nakamura - S et al., "Complications of miniplate osteosynthesis for mandibular fractures". J Oral Maxillofac Surg. 1994; 52(3): 233-8.
56. Nicholas Gerard et al., "Modified technique for adapting a mandibular angle superior border plate". J Oral Maxillofac Surg.1995; 53:220-21.
57. Oginni FO, Ugboko VI, Ogundipe O, Adegbehingbe O. Motorcycle‐related maxillofacial injuries among Nigerian intracity road users. J Oral Maxillofac Surg 2006;64:56‐62. .
58. Oikarinen VJ, Lindquist C. The frequency of facial bone fractures in patients with multiple injuries sustained in traffic accidents. Proc Finn Dent Soc 1975;71:53‐7.
59. R, Jaeger JH, Muster D. Mandibular osteosynthesis by miniature screwed plates via a buccal approach. J Maxillofac Surg. Feb 1978;6(1):14-21. [Medline].
60. R.A Loukota, J.C. Shelton., "Mechanical analysis of maxillofacial miniplates". British Journal of Oral and Macillofacial Surgery. 1995; 33:174-179.
61. Gutwald , Brian Alpert , Rainer Schmelzeisen., "Principle and stability of locking plates". Keijo J Med March 2003; 52(l):21-24.
62. Raymond. J. Fonseca et al., "Oral and Maxillofacial trauma" 1997; 474, 1275 pg.

63. Reza Bolourian et al., “Transoral 2mm miniplate fixation of mandibular fractures plus 2 weeks of maxillomandibular fixation: a prospective study”. J Oral Maxillofac Surg. 2002; 60: 167- 170.

64. Richard H. Haug et al., “A microplate and screw technique for intra oral open reduction of mandibular angle fractures”. J Oral Maxillofac Surg. 1995; 53:218-219.

65. Richard. H. Haug., “The effects of screw number and length in two methods of tension band plating”. J Oral Maxillofac Surg. 1993; 51: 159-62.

66. Robert .A. Rudman et al., “Photo elastic analysis of miniplate osteosynthesis for mandibular angle fractures”. Oral Surg Oral Med Oral-Patho-Oral Radio-endo. 1997;84: 129-36.

67. Schierie. H. P et al., “One or two plate fixation of mandibular angle fractures?” J Carniomaxillo fac Surg. 1997 25(3): 162-8.

68. Shivani Jain , Shipra Gupta. Titanium Miniplates versus Intraosseous Wires as Methods of Fixation of Mandibular Fractures: A Clinical Study. Indian J Stomatol 2011;2(4):238-44

69. Sindet et al., “Treatment of mandibular fractures with or without intermaxillary fixation - a comparative study.” Oral surgery Oral diagnosis. 1992; 3: 37-44.

70. Sirimaharaj W, Pyungtanasup K. The Epidemiology of mandibular fractures treated at Chiang Mai University Hospital: A review of 198 cases. J Med Assoc Thai 2008; 91 (6): 868-74.

71. Subhashraj K, Ramkumar S, Ravindran C. Pattern of mandibular fractures in Chennai, India. Br J Oral Maxillofac Surg 2008;46:126‑7.

72. Smith. W. P., “Delayed miniplate osteosynthesis for mandibular fractures”. Br J Oral Maxillofac Surg. 1991; 29(2): 73-6.

73. Spiessl. B., “Internal fixation of the mandible : A manual of AO/ASIF principles.” 1989: Pg 5 - 37

74. Thoma. K. H., “Treatment of jaw fractures, past and present”. Oral Surgery anaesthesia and Hosp. Dent. Ser. 1959; 17: 30.

75. Thomas KH. Historical review of methods advocated for treatment of jaw fractures with ten commandments for modern fracture treatment. Am J Orthodont Oral Surg. 1944;30:399.

76. Thomas. A. Chiodo et al., “Failure strength of 2.0 locking versus 2.0 conventional Synthes mandibular plates: A laboratory model”. J- Oral and Maxillofacial Surgery. 2006 ; 64 : 1475-1479

77. Valentino et al., “Supplemental Maxillomandibular fixation with miniplate osteosynthesis”. Otolaryngol-Head-Neck-Surg. 1995; 112(2): 215-20.

78. Vivek Shetty et al., “Fracture line stability as a function of the internal fixation system : An in vitro comparison using a mandibular angle fracture model”. J Oral Maxillo fac Surg. 1995; 53: 791-802.

79. Wagner. W. F et al., “Morbidity associated with extra oral open red reduction of mandibular fractures”. Journal of Oral surgery. 1979; 37(2): 97-100.

80. Wald. R. M et al., “The trans oral treatment of mandibular fractures using non compression miniplates : A prospective study”. Annals of plastic surgery. 1988; 20(5): 409-13.

81. Walz. C et at., “Miniplate osteosynthesis of mandibular fracture in local anesthesia -indication and outcome in 316 patients”. Fortschr-Kiefer-Gesichtschir. 1996; 41: 133-5.

82. Wolfgang Heidmann., “Analysis of the osseous metal interface of drill free screws and self tapping screws”. J. Cranio maxillofacial surg. 2001; 29: 69-.

83. Tuovinen., "A retrospective analysis of 279 patients with isolated mandibular fractures treated with titanium miniplates". J Oral Maxillofac Surg. 1994; 52(9): 931-6.

84. Zargar M, Khaji A, Karbakhsh M, Zarei MR. Epidemiologystudy of facial injuries during a 13 month of trauma registry in Tehran. Indian J Med Sci 2004;58:109‑14.

PROFORMA

1. NAME
2. AGE/SEX
3. PS NO
4. ADDRESS
5. MOBILE NO
6. OCCUPATION
7. SOCIOECONOMIC STATUS
8. DATE OF INJURY
9. MODE OF INJURY
10. DATE OF SURGERY/ MMF APPLICATION
11. OTHER CO MORBIDITIES
12. PREOP OPG, CT FACIAL BONES
13. SITE AND NO. OF FRACTURES
14. METHOD OF FIXATION - CLOSED/OPEN
15. TIME AT WHICH ORAL FLUIDS/DIET STARTED
16. IMMEDIATE POST OPERATIVE PERIOD
17. POST OP OPG
18. TIME AT WHICH MOBILISATION STARTED
19. REVIEW EVERY WEEK FOR THE FIRST SIX WEEK AFTER SURGERY
20. THEN MONTHLY FOR THREE MONTHS
21. END OF THIRD MONTH
22. ASSESSMENT

PAIN

MOUTH OPENING

CHEWING

OCCLUSION STATUS

ANY POST OP INFECTION

WEIGHT LOSS

NEUROLOGICAL DISTURBANCE

MASTER CHART - CONSERVATIVE

S .N0	NAME	AGE	SEX	DIAGNOSIS	TIME FROM INJURY	PROCEDURE	MODE OF INJURY	COMPLICATION	OCCLUSION
					TO TREATMENT				
1	Manikandan	48	m	RT Parasymphysis	2 days	Upper and lower eyelet	RTA		CLASS I
2	Kittan	50	M	RT Body ,RT Subcondylar	3 days	Upper and lower arch bar	RAT	TRISMUS	CLASS I
3	Murugesan	27	m	RT Parasymphysis	2 days	Upper and lower arch bar	RTA		CLASS I
4	Prabhu	25	m	RT subcondylar	1 day	Upper eyeleyt and lower arch bar	RTA	PARESTHESIA ,TRISMUS	CLASS I
5	Kithru sirajudeen	48	m	RT Parasymphysis	1 day	Upper eyeleyt and lower arch bar	FALL		CLASS I
6	Kannan	40	m	LT Parasymphysis	1day	Upper and lower arch bar	FALL		CLASS I
7	Chinnaswami	50	m	RT Parasymphysis	1days	Upper and lower arch bar	ASSAULT		CLASS I
8	Arumugam	28	m	BL Sudcondyjar #	2 days	Upper and lower arch bar	RTA	TRISMUS	CLASS I
9	Sundaram	46	m	RT Parasymphysis	1 day	Upper and lower arch bar	RTA		CLASS I
10	Veluswami	39	m	RT Parasymphysis ,RT Subcondylar	2 days	Upper and lower arch bar	RTA	TRISMUS	OPEN BITE
11	Selvam	40	m	LT Subcondylar	1 day	Upper and lower arch bar	RTA	TRISMUS	CLASS I
12	Murugaraj	46	m	LT Parasymphysis	1 day	Upper and lower arch bar	ASSAULT	PARESTHESIA	CLASS I
13	Balaji	31	m	LT Angle	2 days	Upper and lower arch bar	RTA		OPEN BITE
14	SENTHIL	30	M	LT Body	2 days	Upper and lower arch bar	RTA	MALOCCLUSION &MALUNION	CLASS I
15	Sabarinathan	28	m	RT Parasymphysis, LT Angle	2days	Upper and lower arch bar	RTA		CLASS I

MASTER CHART - SURGICAL

S.N0	NAME	AGE	SEX	MODE OF INJURY	DIAGNOSIS	INTERVAL FROM INJURY TO SURGERY	PROCEDURE	COMPLICATION
1	KARTHIK	25	M	RTA	BL PARSYMPHISIS,RT SUBCONDYLAR	7 DAYS	BL DOUBLE 4 HOLE PLATE	PARESTHESIA
2	KUSHBOO	28	F	RTA	RT PARASYMPHYSIS	7 DAYS	4 HOLE PLATE WITH GAP	INFECTED IMPLANT
3	MALAIARASAN	34	M	RTA	BL PARASYMPHYSIS	6 DAYS	TWO 4 HOLE PLATE WITH GAP	PARESTHESIA
4	JOTHIMANI	25	M	RTA	LT BODY	8 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL
5	MADASWAMI	32	M	RTA	LT PARASYMPHYSIS	7 DAYS	TWO 4 HOLE PLATE WITHOUT GAP	NIL
6	SAKTHI	30	M	RTA	LT PARASYMPHYSIS	9 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL
7	VIJAYAKUMAR	25	M	RTA	RT PARASYMPHYSIS,LT BODY	10 DAYS	TWO 4 HOLE PLATE WITH GAP ON BOTH SIDES	PARESTHESIA
8	FATHIMA	45	F	RTA	RT ANGLE ,LT PARASYMPHYSIS	8 DAYS	TWO 4 HOLE PLATE WITH GAP ON BOTH SIDES	NIL

9	KUMAR	30	M	RTA	RT PARSYMPHYSIS, LT ANGLE	10 DAYS	TWO 4 HOLE PLATE WITHOUT GAP,ANGLE NOT FIXED	NIL
10	DAVID	31	M	RTA	LT ANGLE	7 DAYS	LONG PLATE	NIL
11	ARUN	25	M	RTA	RT PARASYMPHYSIS,LT BODY	8 DAYS	TWO 4 HOLE PLATE WITH GAP	MALOCCLUSION
12	MARIMURTU	25	M	RTA	RT PARASYMPHYSIS	5 DAYS	4 AND 3 HOLE PLATE WITH GAP	NIL
13	MALAISELVAN	33	M	ASSAULT	BL PARASYMPHYSIS	6 DAYS	BL 4 HOLE AND 3 HOLE PLATE	NIL
14	MURUGAN	29	M	ASSAULT	RT BODY OF MANDIBLE	7 DAYS	4 HOLE PLATE WITH GAP WITH MMF	NIL
15	IBRAHIM	28	M	RTA	BL PARASYMPHYSIS	5 DAYS	4 HOLE PLATE WITH GAP WITH MMF	NIL
16	RASIYA BANU	35	F	RTA	BL PARASYMPHYSIS	7 DAYS	6 HOLE PLATE WITH GAP,CURVED PLATE	NIL
17	SHANMUGAVEL	25	M	RTA	LT PARASYMPHYSIS	8 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL
18	BOOPALACHANDAR	25	M	RTA	BL PARASYMPHYSIS C SEGMENT	6 DAYS	BL 4 HOLE PLATE WITH GAP	PARESTHESIA
19	ISMAIL	36	M	ASSAULT	LT PARASYMPHYSIS, BL SUB CONDYLE	5 DAYS	4 AND 3 HOLE PLATE WITH GAP	NIL

20	KARTHIK	25	M	RTA	BL PARASYMPHYSIS C SEGMENT	5 DAYS	BL 4 HOLE PLATE WITH GAP	NIL
21	GANESH	35	M	RTA	LT PARASYMPHYSIS	6 DAYS	4 AND 3 HOLE PLATE WITH GAP	NIL
22	SARAVANAN	26	M	RTA	RT PARASYMPHYSIS, LT SUB CONDYLE	10 DAYS	TWO 3 HOLE PLATE WITHOUT GAP WITH MMF	NIL
23	RANGAN	50	M	RTA	RT BODY OF MANDIBLE	7 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL
24	CHANDRASEKAR	34	M	RTA	RT PARASYMPHYSIS, LT ANGLE	5 DAYS	TWO 4 HOLE PLATE WITH GAP,ANGLE TWO 3 HOLE	MALOCCLUSION
25	DEIVANAI	25	F	RTA	BL PARASYMPHYSIS, BL SUB CONDYLE	8 DAYS	BL 4 HOLE PLATE WITH GAP WITH MMF	NIL
26	SARAVANAN	36	M	FALL	RT PARASYMPHYSIS	4 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL
27	DANDAPANI	37	M	FALL	LT BODY OF MANDIBLE	7 DAYS	4 HOLE PLATE WITH GAP	NIL
28	PRAKASH	35	M	ASSAULT	LT PARASYMPHYSIS, BL SUB CONDYLE	8 DAYS	4 AND 3 HOLE PLATE WITH GAP WITH MMF	NIL
29	PALANISWAMI	55	M	RTA	SYMPHYSIS MANDIBLE	5 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL

30	PRAKASH	28	M	RTA	BL PARASYMPHYSIS,LT SUB CONDYLE	7 DAYA	BL TWO 4 HOLE PLATE WITH GAP WITH MMF	NIL
31	DINESH	26	M	RTA	LT PARASYMPHYSIS	9 DAYS	3 AND 4 HOLE PLATE WITH GAP	NIL
32	YASIN	30	M	ASSAULT	LT PARASYMPHYSIS	8 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL
33	SAKTHIVEL	25	M	RTA	RT PARASYMPHYSIS	7 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL
34	SIVAKUMAR	29	M	RTA	RT PARASYMPHYSIS, LT ANGLE	7 DAYS	TWO 4 HOLE PLATE WITH GAP, ANGLE TWO 3 HOLE PLATE	NIL
35	SARAVANAKUMAR	36	M	RTA	LT BODY OF MANDIBLE	9 DAYS	6 AND 3 HOLE PLATE WITH GAP	NIL
36	DASS	25	M	RTA	RT PARASYMPHYSIS,LT RAMUS	7 DAYS	TWO 3HOLE PLATE WITH GAP	NIL
37	SELVAKUMAR	32	m	RTA	LT PARASYMPHYSIS	8 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL
38	SELVARAJ	40	M	RTA	RT PARASYMPHYSIS	7 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL
39	SAMPOORNAM	40	F	RTA	LT PARASYMPHYSIS	8 DAYS	4 HOLE PLATE WITH GAP MMF	INFECTED IMPLANT

40	THIRUMALAIAMMAL	45	F	RTA	RT PARASYMPHYSIS	9 DAYS	TWO 4 HOLE PLATE WITH GAP	INFECTED IMPLANT
41	ESWARAMOORTHI	39	M	RTA	LT PARASYMPHYSIS	5 DAYS	4 HOLE PLATE WITH GAP MMF	INFECTED IMPLANT
42	BALAJI	34	M	RTA	RT PARASYMPHYSIS	10 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL
43	MOHAN	28	M	RTA	RT BODY, LT PARASYMPHYSIS	7 DAYS	BODY 4HOLE PLATE,3 HOLE PLATE FOR PS WITH MMF	MALOCCLUSION
44	LAKSHMI	50	F	RTA	RT ANGLE OF MANDIBLE	8 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL
45	ZAKIR HUSSAIN	39	M	RTA	RT PARASYMPHYSIS, LT RAMUS	5 DAYS	SINGLE 4 HOLE PLATE WITH GAP FOR BOTH WITH MMF	NIL
46	SIVASUBRAMANIAN	45	M	RTA	RT BODY OF MANDIBLE	6 DAYS	4 HOLE PLATE WITH GAP WITH SS WIRE AND MMF	INFECTED IMPLANT
47	RAJAMURUGAN	26	M	FALL	RT ANGLE LT BODY	8DAYS	TWO 4 HOLE PLATE WITH GAP	MALOCCLUSION
48	SENTHIL	30	M	RTA	LT BODY	7 DAYS	TWO 4 HOLE WITH GAP	NIL
49	DEVI	50	F	RTA	LT PARASYMPHYSIS	8 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL
50	XAVIER	37	M	RTA	LT PARASYMPHYSIS	7 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL

51	SURESH	40	M	FALL	RT PARASYMPHYSIS, LT BODY	8 DAYS	PS 4HOLE PLATE WITHOUT GAP,BODY RECON PLATE WITH MMF	NIL
52	AYYAPPAN	29	M	FALL	LT BODY	9 DAYS	TWO 4 HOLE PLATE WITH GAP	NIL